F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress

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Summary

The administration's proposed FY2010 defense budget requests about $10.4 billion in research and development and procurement funding for the F-35 Joint Strike Fighter (JSF) program. The proposed FY2010 budget would fund the procurement of 10 F-35As for the Air Force, 16 F-35Bs for the Marine Corps, and four F-35Cs for the Navy.

The administration's proposed FY2010 defense budget also proposes to terminate the F-35 alternate engine program, which is intended to develop the General Electric/Rolls-Royce F136 engine as an alternative to the Pratt and Whitney F135 engine that currently powers the F-35. The F-35 alternate engine program has emerged as a major item of debate on the FY2010 defense budget. The Obama administration opposes further funding for the alternate engine program and has threatened to veto the FY2010 defense authorization or appropriation bill if either "would seriously disrupt" the F-35 program.

FY2010 defense authorization bill: The conference report (H.Rept. 111-288 of October 7, 2009) on the FY2010 defense authorization bill (H.R. 2647) authorizes funding for procuring a total of 30 F-35s in FY2010, as requested. The report authorizes $430 million in Air Force and Navy research and development funding for continued development of the F136 alternate engine, and $130 million in Air Force advance procurement funding to begin procurement of F136 engines.

Section 131 of the bill requires a report on the procurement of "4.5"-generation fighters that is to include, among other things, "a discussion regarding the availability and feasibility of procuring F-35 aircraft to proportionally and concurrently recapitalize the Air National Guard during fiscal years 2015 through fiscal year 2025." Section 217 requires future DOD budgets to provide separate line items for the F-35B and F-35C within the Navy aircraft procurement account and the Navy research and development account. Section 244 requires, for the period 2010-2015, an annual Government Accountability Office (GAO) report on the status of the F-35 program.

FY2010 DOD appropriations bill: The FY2010 Department of Defense (DOD) appropriations bill (H.R. 3326) as reported by the House Appropriations Committee (H.Rept. 111-230 of July 24, 2009) recommends reducing procurement of F-35s by two aircraft from the administration's request (two F-35Bs), and increasing funding for the F-35 alternate engine program.

H.R. 3326 as reported by the Senate Appropriations Committee (S.Rept. 111-74 of September 10, 2009) recommends procuring a total of 30 F-35s in FY2010, as requested. The report recommends a $22-million reduction to the administration's procurement and advance procurement funding request for the F-35 program and recommends a $156-million reduction to the administration's research and development funding request for the F-35 program. The committee's report does not recommend any funding for the F-35 alternate engine program.

Contents

Tables

Appendixes

Contacts

Introduction

In General

The F-35 Joint Strike Fighter (JSF), also called the Lighting II, is a new strike fighter being procured in different versions by the Air Force, Marine Corps, and Navy. Procurement of F-35s began in FY2007. The F-35 program is the Department of Defense's (DOD's) largest weapon procurement program in terms of total estimated acquisition cost. Current DOD plans call for acquiring a total of 2,456 JSFs for the Air Force, Marine Corps, and Navy at an estimated total acquisition cost (as of December 31, 2007) of about $246 billion in constant (i.e., inflation-adjusted) FY2009 dollars. Hundreds of additional F-35s are expected to be purchased by several U.S. allies.

The administration's proposed FY2010 defense budget requests a total of about $10.4 billion in Air Force and Navy research and development funding and procurement funding for the F-35 program, including about $3.6 billion in Air Force and Navy research and development funding and about $6.8 billion in Air Force and Navy procurement funding. (Development and procurement of Marine Corps aircraft are funded through the Navy's budget.) The proposed FY2010 budget would fund the procurement of 10 F-35As for the Air Force, 16 F-35Bs for the Marine Corps, and four F-35Cs for the Navy.

The administration's proposed FY2010 defense budget also proposes to terminate the F-35 alternate engine program, which is intended to develop the General Electric/Rolls-Royce F136 engine as an alternative to the Pratt and Whitney F135 engine that currently powers the F-35. The George W. Bush administration proposed terminating the alternate engine program in FY2007, FY2008, and FY2009. Congress rejected these proposals and provided funding, bill language, and report language for the program's continuation. The F-35 alternate engine program has emerged as a major item of debate on the FY2010 defense budget. The Obama administration opposes further funding for the alternate engine program and has threatened to veto the FY2010 defense authorization or appropriation bill if either "would seriously disrupt" the F-35 program.

The issues for Congress for FY2010 are whether to approve or reject the administration's proposal to terminate the alternate engine program, and whether to approve, reject, or modify the administration's overall funding request for the F-35 program. Congress's decisions on these matters will affect DOD capabilities and funding requirements and the tactical aircraft manufacturing industrial base.

Alternate Engine Program

Introductory information on the F-35 alternate engine program is presented in the "Background" section of this report. In the following "Issues for Congress" section, the alternate engine program is the first issue discussed. **Appendix A** presents details from the legislative history of the alternate engine issue.

Background

The F-35 In Brief

The F-35 was conceived as a relatively affordable fifth-generation strike fighter[1] that could be procured in three highly common versions for the Air Force, the Marine Corps, and the Navy, so that the three services could avoid the higher costs of developing, procuring, and operating and supporting three separate tactical aircraft designs to meet their similar but not identical operational needs.[2]

DOD states that the F-35 program "was structured from the beginning to be a model of acquisition reform, with an emphasis on jointness, technology maturation and concept demonstrations, and early cost and performance trades integral to the weapon system requirements definition process."[3]

All three versions of the F-35 will be single-seat aircraft with supersonic dash capability and some degree of stealth. The three versions will vary somewhat in their combat ranges and payloads (see the **Appendix B**). All three are to carry their primary weapons internally to maintain a stealthy radar signature. Additional weapons can be carried externally on missions requiring less stealth. The Air Force states that:

> The F-35 program will develop and deploy a family of highly capable, affordable, fifth generation strike fighter aircraft to meet the operational needs of the Air Force, Navy, Marine Corps, and Allies with optimum commonality to minimize life cycle costs. The F-35 was designed from the bottom-up to be our premier surface-to-air missile killer and is uniquely equipped for this mission with cutting edge processing power, synthetic aperture radar integration techniques, and advanced target recognition. The F-35 also provides "leap ahead" capabilities in its resistance to jamming, maintainability, and logistic support.[4]

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[1] Fifth-generation aircraft incorporate the most modern technology, and are considered to be generally more capable than earlier-generation (e.g., 4th-generation and below) aircraft. Fifth-generation fighters combine new developments such as thrust vectoring, composite materials, supercruise (the ability to cruise at supersonic speeds without using engine afterburners), stealth technology, advanced radar and sensors, and integrated avionics to greatly improve pilot situational awareness. Currently, only the Air Force F-22 air superiority fighter and the F-35 are considered fifth-generation aircraft. Russia reportedly has a fifth-generation fighter under development.

Strike fighters are dual-role tactical aircraft that are capable of both air-to-ground (strike) and air-to-air (fighter) combat operations.

[2] The program's operational requirements call for 70% to 90% commonality between all three versions. Many of the three versions' high-cost components—including their engines, avionics, and major airframe structural components—are common.

Secretary of Defense William Cohen stated in 2000 that the JSF's joint approach "avoids the three parallel development programs for service-unique aircraft that would have otherwise been necessary, saving at least $15 billion." (Letter from Secretary of Defense William S. Cohen to Rep. Jerry Lewis, June 22, 2000. The text of letter made available by *Inside the Air Force* on June 23, 2000.)

[3] Department of Defense. *Selected Acquisition Report (SAR)[for] F-35 (JSF)*, December 31, 2007, p. 4.

[4] Department of the Air Force Presentation to the House Armed Services Committee Subcommittee on Air and Land Forces, United States House of Representatives, Subject: Air Force Programs, Combined Statement of: Lieutenant General Daniel J. Darnell, Air Force Deputy Chief Of Staff For Air, Space and Information Operations, Plans And Requirements (AF/A3/5) [and] Lieutenant General Mark D. Shackelford, Military Deputy, Office of the Assistant Secretary of the Air Force for Acquisition (SAF/AQ) Lieutenant General Raymond E. Johns, Jr., Air Force Deputy (continued...)

Three Versions

Air Force CTOL Version (F-35A)

The Air Force is procuring the F-35A, a conventional takeoff and landing (CTOL) version of the aircraft. F-35As are to replace Air Force F-16 fighters and A-10 attack aircraft. The F-35A is intended to be a more affordable complement to the Air Force's new F-22 Raptor air superiority fighter (which is replacing the service's aging F-15 air superiority fighters).[5] Compared to the F-22, the F-35A is not quite as stealthy and not as capable in air-to-air combat, but it is still very capable in both these areas, and is also very capable in air-to-ground combat. The F-35 is more stealthy and more capable in air-to-air and air-to-ground combat than the F-16. If the F-15/F-16 combination represented the Air Force's earlier-generation "high-low" mix of air superiority fighters and more-affordable dual-role aircraft, then the F-22/F-35A combination might be viewed as the Air Force's intended future high-low mix of air superiority fighters and more-affordable dual-role aircraft.[6] The Air Force states that:

> Both the F-22A and the F-35 represent our latest generation of fighter aircraft. We need both aircraft to maintain the margin of superiority we have come to depend upon, the margin that has granted our forces in the air and on the ground freedom to maneuver and to attack. The F-22A and F-35 each possess unique, complementary, and essential capabilities that together provide the synergistic effects required to maintain that margin of superiority across the spectrum of conflict. The OSD-led 2006 QDR Joint Air Dominance study underscored that our Nation has a critical requirement to recapitalize TACAIR forces. Legacy 4th generation aircraft simply cannot survive to operate and achieve the effects necessary to win in an integrated, anti-access environment.[7]

The Department of the Navy states that:

> The commonality designed into the joint F-35 program will minimize acquisition and operating costs of Navy and Marine Corps tactical aircraft, and allow enhanced interoperability with our sister Service, the United States Air Force, and the eight partner nations participating in the development of this aircraft. This aircraft will give combatant commanders greater flexibility across the range of military operations. A true fifth generation aircraft, the F-35 will enhance precision strike capability through unprecedented stealth, range, sensor fusion, improved radar performance, combat identification and electronic attack capabilities compared to legacy platforms. It will also add sophisticated electronic

(...continued)

Chief of Staff for Strategic Plans And Programs (AF/A8) May 20, 2009, p. 10.

[5] For more on the F-22 program, see CRS Report RL31673, *Air Force F-22 Fighter Program: Background and Issues for Congress*, by Ronald O'Rourke

[6] The term high-low mix refers to a force consisting of a combination of high-cost, high-capability aircraft and lower-cost, more-affordable aircraft. Procuring a high-low mix is a strategy for attempting to balance the goal for having a certain minimum number of very high capability tactical aircraft to take on the most challenging projected missions and the goal of being able to procure tactical aircraft sufficient in total numbers within available resources to perform all projected missions.

[7] Department of the Air Force Presentation to the House Armed Services Committee Subcommittee on Air and Land Forces, United States House of Representatives, Subject: Air Force Programs, Combined Statement of: Lieutenant General Daniel J. Darnell, Air Force Deputy Chief Of Staff For Air, Space and Information Operations, Plans And Requirements (AF/A3/5) [and] Lieutenant General Mark D. Shackelford, Military Deputy, Office of the Assistant Secretary of the Air Force for Acquisition (SAF/AQ) Lieutenant General Raymond E. Johns, Jr., Air Force Deputy Chief of Staff for Strategic Plans And Programs (AF/A8) May 20, 2009, pp. 7-8.

> warfare capabilities, as compared to the legacy platforms it will replace, and will tie together disparate units scattered across the battlefield, in real time.[8]

Marine Corps STOVL Version (F-35B)

The Marine Corps is procuring the F-35B, a short takeoff and vertical landing (STOVL) version of the aircraft.[9] F-35Bs are to replace Marine Corps AV-8B Harrier vertical/short takeoff and landing (VSTOL) attack aircraft and Marine Corps F/A-18A, C, and D strike fighters, which are CTOL aircraft. The F-35B and the V-22 Osprey tilt-rotor aircraft[10] are central to achieving a long-term Marine Corps goal for phasing out the service's CTOL aircraft and fielding an all-VSTOL Marine Corps aviation capability. The Marine Corps decided to not procure F/A-18E/F strike fighters[11] and instead wait for the F-35B in part because the F/A-18E/F is a CTOL aircraft. The Department of the Navy states that:

> The F-35B Short Take-off Vertical Landing (STOVL) variant combines the multi-role versatility and strike fighter capability of the legacy F/A-18 with the basing flexibility of the AV-8B. Having these capabilities in one aircraft will provide the joint force commander and the MAGTF [Marine Air-Ground Task Force] commander unprecedented strategic and operational agility.
>
> The Marine Corps' tactical aviation (TACAIR) fixed-wing platforms, used for direct support to our ground combat Marines in the fight, are the AV-8B Harrier, the F/A-18 A+/C/D Hornet and the EA-6B Prowler. These aircraft are approaching the end of their planned service lives, and the Marine Corps, through careful service life extension programs, has managed these legacy platforms to bridge our aviation force until future airframes come on line. The Marines' F-35B will replace both the AV-8B and F/A-18 A+/C/D, as well as fill a large portion of the EA-6B mission as part of a networked system of systems. The Marine Corps intends to leverage the F-35B's sophisticated sensor suite and very low observable (VLO), fifth generation strike fighter capabilities, particularly in the area of data collection, to support the Marine Air Ground Task Force (MAGTF) well beyond the abilities of today's strike and EW assets.[12]

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[8] Statement of Vice Admiral David Architzel, USN, Principal Military Deputy, Research, Development and Acquisition, LTGEN George J. Trautman III, USMC, Deputy Commandant for Aviation, [and] RADM Allen G. Myers, USN, Director of Warfare Integration, Before the Seapower and Expeditionary Warfare [sic: Forces] Subcommittee of the House Armed Services Committee [hearing] on [the] Department of the Navy's Aviation Procurement Program, May 19, 2009, p. 1.

[9] To permit STOVL operations, the F-35B has an engine exhaust nozzle at the rear than can swivel downward, and a mid-fuselage lift fan connected to the engine that blows air downward to help lift the forward part of the plane.

[10] For more on the V-22 program, see CRS Report RL31384, *V-22 Osprey Tilt-Rotor Aircraft: Background and Issues for Congress*, by Ronald O'Rourke.

[11] For more on the F/A-18E/F program, see CRS Report RL30624, *Navy F/A-18E/F and EA-18G Aircraft Procurement and Strike Fighter Shortfall: Background and Issues for Congress*, by Ronald O'Rourke.

[12] Statement of Vice Admiral David Architzel, USN, Principal Military Deputy, Research, Development and Acquisition, LTGEN George J. Trautman III, USMC, Deputy Commandant for Aviation, [and] RADM Allen G. Myers, USN, Director of Warfare Integration, Before the Seapower and Expeditionary Warfare [sic: Forces] Subcommittee of the House Armed Services Committee [hearing] on [the] Department of the Navy's Aviation Procurement Program, May 19, 2009, pp. 1-2.

Navy Carrier-Suitable Version (F-35C)

The Navy is procuring the F-35C, a carrier-suitable CTOL version of the aircraft.[13] The F-35C is also known as the CV version of the F-35, with CV meaning aircraft carrier. The Navy in the future plans to operate carrier air wings featuring a strike fighter combination of F/A-18E/Fs (which the Navy has been procuring since FY1997) and F-35Cs. The F/A-18E/F is generally considered a fourth-generation strike-fighter. (Some F/A-18E/F supporters argue that it is a "fourth-plus" or "4.5"generation strike fighter because it incorporates some fifth-generation technology, particularly in its sensors.) The F/A-18E/F incorporates a few stealth features, but the F-35C is stealthier. The F/A-18E/F is less expensive to procure than the F-35C. In contrast to the Air Force, which has operated stealthy bombers and fighters for years, the F-35C is to be the Navy's first considerably stealthy aircraft. The Department of the Navy states that:

> The F-35C carrier variant (CV) complements the F/A-18E/F Block II and EA-18G in providing survivable, long-range strike capability and persistence over the battlefield. The F-35 will give the ESG and CSG commanders a survivable "Day-One" strike capability in a denied access environment that can not be accomplished by current legacy aircraft. [14]

Alternate Engine Program

The F-35 is powered by the Pratt and Whitney F135 engine, which was derived from the F-22's Pratt and Whitney F119 engine. The F135 is produced in Pratt and Whitney's facilities in East Hartford and Middleton, CT. Pratt and Whitney's parent firm is United Technologies. Rolls-Royce is a subcontractor to Pratt and Whitney for the vertical lift system for the F-35B.

Consistent with congressional direction for the FY1996 defense budget (see **Appendix A**), DOD established a program to develop an alternate engine for the F-35. The alternate engine, the F136, is being developed by a team consisting of General Electric (GE) and Rolls-Royce. The team includes GE Transportation—Aircraft Engines of Cincinnati, OH, and Rolls-Royce PLC of Bristol, England, and Indianapolis, IN. The F136 is a derivative of the F120 engine that was originally developed to compete with the F119 engine for the F-22 program.

A September 24, 2009, DOD information paper on the alternate engine program provided to CRS states the following:

- Pratt and Whitney has received a total of $7.3 billion in funding during the period FY1994-FY2009 for work relating to the F-35 program. This figure includes funding for work that was performed during the Concept Demonstration phase of the F-35 program for the Boeing concept for the JSF (a concept that was not selected for System Development and Demonstration [SDD]). The total of $7.3 billion includes $6.1 billion received during the period FY2002-FY2009 for F135

[13] Features for carrier suitability include, among other things, strengthened landing gear, a strengthened airframe, and an arresting hook so as to permit catapult launches and arrested-wire landings, as well as folding wing tips for more compact storage aboard ship.

[14] Statement of Vice Admiral David Architzel, USN, Principal Military Deputy, Research, Development and Acquisition, LTGEN George J. Trautman III, USMC, Deputy Commandant for Aviation, [and] RADM Allen G. Myers, USN, Director of Warfare Integration, Before the Seapower and Expeditionary Warfare [sic: Forces] Subcommittee of the House Armed Services Committee [hearing] on [the] Department of the Navy's Aviation Procurement Program, May 19, 2009, p. 1.

SDD work. The estimated cost of the F135 SDD contract increased from $4.8 billion at contract award in 2001 to $6.7 billion as of September 2009. Approximately $0.8 billion of the increase is cost growth; the remaining $1.1 billion or so reflects an increase in the scope of work to be performed.

- The General Electric/Rolls-Royce team received a total of $2.4 billion during the period FY1995-FY2009. This total includes $1.7 billion for SDD work for the F136 engine during the period FY2005-FY2009. The F136 GE/Rolls-Royce team's effort does not include design, development, test, and delivery of STOVL Lift System components and exhaust systems, which are developed and provided under the F135 Pratt and Whitney SDD contract. The F136 SDD contract consequently includes fewer test hours and fewer ground test engines. In addition, since the F136 SDD flight qualification occurs later in the F-35 SDD program, fewer flight test engines would be needed.[15]

DOD included the F-35 alternate program in its proposed budgets through FY2006, although Congress in certain years increased funding for the program above the requested amount and/or included bill and report language supporting the program.

The George W. Bush administration proposed terminating the alternate engine program in FY2007, FY2008, and FY2009. Congress rejected these proposals and provided funding, bill language, and report language for the program's continuation. Bill language since FY2007 includes Section 211 of the FY2007 defense authorization act (H.R. 5122/P.L. 109-364 of October 17, 2006) and Section 213 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181 of January 28, 2008). (For the texts of these two provisions, see **Appendix A**.)

The F-35 alternate engine program has emerged as a major item of debate on the FY2010 defense budget. The Obama administration opposes further funding for the alternate engine program and has threatened to veto the FY2010 defense authorization or appropriation bill if either "would seriously disrupt" the F-35 program. (See "Legislative Activity for FY2010.")

In the "Issues for Congress" section of this report, the alternate engine program is the first issue discussed. **Appendix A** presents details from the legislative history of the issue.

[15] DOD information paper on F-35 program dated September 24, 2009, provided to CRS by Air Force Legislative Liaison Office on September 29, 2009.

Program Origin and Milestones

The JSF program began in the early- to mid-1990s.[16] Three different airframe designs were proposed by Boeing, Lockheed, and McDonnell Douglas (the last teamed with Northrop Grumman and British Aerospace). On November 16, 1996, the Defense Department announced that Boeing and Lockheed Martin had been chosen to compete in the Concept Demonstration Phase (CDP) of the program, with Pratt and Whitney providing propulsion hardware and engineering support. Boeing and Lockheed were each awarded contracts to build and test-fly two aircraft to demonstrate their competing concepts for all three planned JSF variants.

The competition between Boeing and Lockheed Martin was closely watched: Given the size of the JSF program and the expectation that the JSF might be the last fighter aircraft program that DOD would initiate for many years, DOD's decision on the JSF program was expected to shape the future of both U.S. tactical aviation and the U.S. tactical aircraft industrial base.

In October 2001, DOD selected the Lockheed design as the winner of the competition, and the JSF program entered the System Development and Demonstration (SDD) phase. SDD contracts were awarded to Lockheed Martin (for the aircraft) and Pratt and Whitney (for the aircraft's engine). General Electric continued technical efforts related to the development of an alternate engine for competition in the program's production phase.[17]

The first flights of the F-35A and F-35B occurred in the first quarter of FY2007 and the third quarter of FY2008, respectively.[18] Under the FY2010 budget submission, the first flight of an optimized design for the F-35A (i.e., a slightly changed design for the F-35A) is scheduled for the third quarter of FY2009, and the first flight of the F-35C is scheduled for the first quarter of FY2010.

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[16] The JSF program emerged in late 1995 from the Joint Advanced Strike Technology (JAST) program, which began in late 1993 as a result of the Clinton administration's Bottom-Up Review (BUR) of U.S. defense policy and programs. The BUR envisaged the JAST program as a replacement for two other tactical aircraft programs that were being terminated (the A-12 program, which was intended to provide a stealthy new carrier-based attack plane to replace the Navy's aging A-6 carrier-based attack planes, and the multi-role fighter [MRF], which was the Air Force had considered as a replacement for its F-16 fighters).

In 1995, in response to congressional direction, a program led by the Defense Advanced Research Projects Agency (DARPA) to develop an advanced short takeoff and vertical landing (ASTOVL) aircraft was incorporated into the JAST program. This opened the way for Marine Corps and UK participation in the JAST program, since the Marine Corps and the UK were interested procuring a new STOVL aircraft to replace their aging Harrier STOVL attack aircraft. The name of the program was then changed to Joint Strike Fighter (JSF) to focus on joint development and production of a next-generation fighter/attack plane.

A Joint Operational Requirements Document (JORD) for the F-35 program was issued in March 2000 and revalidated by DOD's Joint Requirements Oversight Council (JROC) in October 2001.

[17] On October 24, 2001, the Defense Acquisition Board (DAB) held a Milestone B review for the program. (Milestone B approval would permit the program to enter the SDD phase.) On October 25, 2001, the Secretary of Defense certified to Congress (in accordance with Section 212 of the FY2001 defense authorization act [H.R. 4205/P.L. 106-398 of October 30, 2000]) that the program had successfully completed the CDP exit criteria and demonstrated sufficient technical maturity to enter SDD. On October 26, 2001, the SDD contracts were awarded to Lockheed and Pratt and Whitney.

[18] A Preliminary Design Review (PDR) for the F-35 program was conducted in April 2003, and Critical Design Reviews (CDRs) were held for the F-35A, F-35B, and F-35C in February 2006 (F-35A and F-35B) and June 2007 (F-35C).

The F-35A, F-35B, and F-35C are scheduled to achieve Initial Operational Capability (IOC) in March 2013, March 2012, and September 2014, respectively. Note that the scheduled IOC of the F-35B is a year earlier than that of the F-35A. The September 2014 IOC for the F-35C was announced by the Navy in September 2009; prior to the announcement, the F-35Cs was scheduled to achieve IOC six months later, in March 2015.[19]

Procurement Quantities

Planned Total Quantities

As of December 31, 2007, the F-35 program included a planned total of 2,456 aircraft—13 research and development aircraft and a planned total of 2,443 production aircraft. The 2,443 production aircraft include 1,763 F-35As for the Air Force and 680 F-35Bs and Cs for the Marine Corps and Navy, with exact numbers of Bs and Cs not yet determined.[20] These planned production totals are subject to review in the Quadrennial Defense Review (QDR) that is to be reported to Congress with the submission of the proposed FY2011 defense budget in February 2010. A June 3, 2009, press report states:

> Air Force Chief of Staff Norton Schwartz today signaled that the service's requirement for 1,763 F-35 Joint Strike Fighters is being examined during the comprehensive Quadrennial Defense Review now under way. Whether the Air Force ultimately buys more or fewer F-35s than planned depends on that review of military capabilities and requirements, the four-star general told the House Defense Appropriations Subcommittee. Indeed, the Air Force's plan to field a total of 2,250 fighters, both old and new, is also under review, according to Schwartz.
>
> "It could end up being less," he said, adding, "if that's the case, we will still have a predominately F-35" force. Still, Schwartz said he expects to have "well over" 1,500 F-35s.[21]

Annual Quantities

Procurement of F-35s began in FY2007. **Table 1** shows actual F-35 procurement quantities through FY2009 and requested procurement quantities for FY2010. The figures in the table do not include 13 research and development aircraft procured with research and development funding.

[19] Andrew Tilghman, "Joint Strike Fighter Timeline Moved Up," *NavyTimes.com*, September 18, 2009; Dan Taylor, "Navy Officially Changes IOC For JSF Carrier Variant From 2015 to 2014," *Inside the Navy*, September 21, 2009.

[20] In 1996, preliminary planning estimated over 3,000 F-35s for DOD and the UK: 2,036 for the Air Force, 642 for the Marines, 300 for the U.S. Navy, and 60 for the Royal Navy. In May 1997, the QDR recommended reducing projected DOD procurement from 2,978 to 2,852: 1,763 for the Air Force, 609 for the Marines, and 480 for the Navy. (Quadrennial Defense Review Cuts Procurement in FY1999, 2000, *Aerospace Daily*, May 20, 1997, p. 280.) In 2003, the Department of the Navy (DON) reduced its planned procurement of 1,089 F-35s to 680 aircraft as part of the Navy/Marine Corps Tactical Aviation Integration Plan. (See CRS Report RS21488, *Navy-Marine Corps Tactical Air Integration Plan: Background and Issues for Congress*, by Christopher Bolkcom and Ronald O'Rourke.)

[21] "Air Force Need For F-35s Under Review," *National Journal's CongressDailyPM*, June 3, 2009.

Table 1. Annual F-35 Procurement Quantities

(Figures shown are for production aircraft; table excludes 13 research and development aircraft)

FY	F-35A (USAF)	F-35B (USMC)	F-35C (Navy)	Total
2007	2	0	0	2
2008	6	6	0	12
2009	7	7	0	14
2010 (request)	10	16	4	30

Source: Prepared by CRS based on DOD data.

Past DOD plans have contemplated increasing the procurement rate of F-35As for the Air Force to a sustained rate of 80 aircraft per year by FY2015, and completing the planned procurement of 1,763 F-35As by about FY2034. Past DOD plans have also contemplated increasing the procurement rate of F-35Bs and Cs for the Marine Corps and Navy to a combined sustained rate of 50 aircraft per year by about FY2014, and completing the planned procurement of 680 F-35Bs and Cs by about FY2025.

Program Management

The JSF program is jointly staffed and managed by the Department of the Air Force and the Department of the Navy (DON). Service Acquisition Executive (SAE) responsibility alternates between the two departments. When the Air Force has SAE authority, the F-35 program director is from DON, and vice versa. The Air Force resumed SAE authority in April 2009.[22]

International Participation

The F-35 program features a significant amount of international participation, making it DOD's largest international cooperative program. Allied participation has been actively pursued by DOD as a way to defray some of the cost of developing and producing the aircraft, and to "prime the pump" for export sales of the aircraft.[23] Allies in turn view participation the F-35 program as an affordable way to acquire a fifth-generation strike fighter, technical knowledge in areas such as stealth, and industrial opportunities for domestic firms.

[22] In 2004, appropriations conferees followed a House recommendation to direct DOD to review this alternative management arrangement. House appropriators believed that "management of program acquisition should remain with one Service, and that the U.S. Navy, due to its significant investment in two variants of the F-35 should be assigned all acquisition executive oversight responsibilities." (H.Rept. 108-553 [H.R. 4613], p. 234) Conferees directed that DOD submit a report on the potential efficacy of this change. Prior to the release of the DOD report, former Air Force Chief of Staff General John Jumper was quoted as saying that he also supported putting one service in charge of JSF program acquisition. (Elizabeth Rees, "Jumper Supports Single Service Retaining JSF Acquisition Oversight," *Inside the Air Force*, August 6, 2004.) However, General Jumper highlighted the significant investment the Air Force was making in the JSF program in response to the congressional language favoring the Navy. In DOD's response to Congress, the report noted the current arrangement ensures one Service does not have a "disproportionate voice" when it comes to program decisions and that the current system is "responsive, efficient, and in the best interests of the success of the JSF program." (U.S. Department of Defense, *Report to Congress on Joint Strike Fighter Management Oversight* [forwarded by] Michael W. Wynne, Under Secretary of Defense for Acquisition, Technology and Logistics, December 20, 2004.)

[23] Congress insisted from the outset that the JAST program include ongoing efforts by DARPA to develop more advanced STOVL aircraft, opening the way for UK participation in the program.

Eight allied countries—the United Kingdom, Canada, Denmark, The Netherlands, Norway, Italy, Turkey, and Australia—are participating in the F-35 program under Memoranda of Understanding (MOUs) for the SDD and Production, Sustainment, and Follow-On Development (PSFD) phases of the program. These eight countries have contributed varying amounts of research and development funding to the program, receiving in return various levels of participation in the program. International partners are also assisting with Initial Operational Test and Evaluation (IOT&E), a subset of SDD.[24] The eight partner countries are expected to purchase hundreds of F-35s, with the United Kingdom being the largest anticipated foreign purchaser.[25] Two additional countries—Israel and Singapore—are security cooperation participants outside the F-35 cooperative development partnership,[26] and sales to additional countries are possible.[27] Some officials have speculated that foreign sales of F-35s might eventually surpass 2,000 or even 3,000 aircraft.[28]

The UK is the most significant international partner in terms of financial commitment, and the only Level 1 partner.[29] On December 20, 1995, the U.S. and UK governments signed a

[24] Currently, the UK, Italy, and the Netherlands have agreed to participate in the IOT&E program. UK, the senior F-35 partner, will have the strongest participation in the IOT&E phase. Italy and the Netherlands are contributing a far smaller amount and will take part only in the coalition concept of operations (CONOPS) validation testing. (Telephone conversation with OSD/AT&L, October 3, 2007.) Other partner nations are still weighing their option to participate in the IOT&E program. The benefits to participation are expedited acquisition of aircraft, pilot training for the test cycle, and access to testing results.

[25] Anticipated orders are as follows: UK: 138; Italy: 131; Australia: 100; Turkey: 100; Canada: 88; Netherlands: 85; Denmark: 48; Norway: 48. (Michael Sirak, "F-35 Nations on Track to Sign New MOU, Says JSF Program Office," *Defense Daily*, November 20, 2006.)

[26] DOD offers Foreign Military Sales (FMS)-level of participation in the F-35 program for countries unable to commit to partnership in the program's SDD phase. Israel and Singapore are believed to have contributed $50 million each, and they are "Security Cooperative Participants." (Selected Acquisition Report. Office of the Secretary of Defense for Acquisition. December 31, 2005.) In October 2008, it was reported that the Bush administration had authorized sale of the F-35 to Israel. (Caitlin Harrington. "US approves F-35 sale to Israel." *Jane's Defense Weekly*. October 1, 2008) and that Tel Aviv was prepared to spend as much as $15 billion to procure 25 F-35s. ("Israel Looks to Spend $15 Billion for CTOL Variant of F-35." *Defense Daily*. October 1, 2008.) In July 2009, it was reported that Israel wants to purchase up to 75 F-35s. (Tony Capaccio, "Israel Seeks To Buy Up To 75 Lockheed F-35 Fighter Jets," *Bloomberg News*, July 25, 2009: 1C.)

[27] F-35 program officials have discussed the aircraft with the defense staffs of many other allied countries as prospective customers, including Germany, Greece, and Spain.

[28] See, for example, Marina Malenic, "F-35 Sales Could Double As Countries Look To Replace Aging Fleets, General Says," *Defense Daily*, June 18, 2009: 6. See also Marcus Weisgerber, "JSF Program Anticipates Nearly 700 F-35 Buys [For International Customers] Between FY-09 and FY-23, *Inside the Air Force*, July 31, 2009.

[29] International participation in the F-35 program is divided into three levels, according to the amount of money a country contributes to the program—the higher the amount, the greater the nation's voice with respect to aircraft requirements, design, and access to technologies gained during development. Level 1 Partner status requires approximately 10% contribution to aircraft development and allows for fully integrated office staff and a national deputy at director level.

Level II partners consist of Italy and the Netherlands, contributing $1 billion and $800 million, respectively. On June 24, 2002, Italy became the senior Level II partner. ("F-35 Joint Strike Fighter (JSF) Lightning II: International Partners," http://www.globalsecurity.org/military/systems/aircraft/f-35-int.htm, accessed on October 3, 2007.) Italy wants to have its own F-35 final assembly line, which would be in addition to a potential F-35 maintenance and upgrade facility. The Netherlands signed on to the F-35 program on June 17, 2002, after it had conducted a 30-month analysis of potential alternatives.

Australia, Denmark, Norway, Canada, and Turkey joined the F-35 program as Level III partners, with contributions ranging from $125 million to $175 million. ("Australia, Belgium Enter Joint Strike Fighter Program as EMD Partners," *Inside the Air Force*, April 21, 2000.)

Unlike the SDD phase, PSFD phase does not make any distinction as to levels of participation. Also unlike the bilateral (continued...)

memorandum of understanding (MOU) on British participation in the JSF program as a collaborative partner in the definition of requirements and aircraft design. This MOU committed the British government to contribute $200 million toward the cost of the 1997-2001 Concept Demonstration Phase.[30] On January 17, 2001, the U.S. and UK governments signed an MOU finalizing the UK's participation in the SDD phase, with the UK committing to spending $2 billion for SDD, which equated to about 8% of the estimated cost of the SDD phase. A number of UK firms, such as BAE and Rolls-Royce, participate in the F-35 program.[31]

Friction has existed at times between DOD and foreign partners in the JSF program. Denmark, Italy, the Netherlands, Norway, and Turkey in 2003-2004 expressed dissatisfaction with the quality and quantity of the work their companies had been awarded on the F-35.[32] These countries threatened to reduce their participation in the program, or purchase other European fighters instead of the F-35. The governments of Italy and the United Kingdom have lobbied for F-35 assembly facilities to be established in their countries.

In 2008, it was reported that some of the partners were attempting to team with others and present a more united position vis-a-vis Lockheed so as to more effectively negotiate the terms of their involvement.[33] As of 2008, international content in the initial F-35 aircraft was approximately 20%.[34] Lockheed Martin expects international content to potentially expand to about 30% as the program transitions to full-rate production and the supply base potentially diversifies.[35]

Technology transfer has been an issue in the F-35 program, with some of the foreign partners arguing that the United States has been too cautious in sharing the JSF's technical capabilities.

(...continued)

SDD MOUs, there is a single PSFD MOU for all partner nations. In signing the PSFD MOU, partner nations state their intentions to purchase the F-35, including quantity and variant, and a determination is made as to their delivery schedule. PSFD costs will be divided on a "fair-share" based on the programmed purchase amount of the respective nation. So-called "offset" arrangements, considered the norm in defense contracts with foreign nations, usually require additional incentives to compensate the purchasing nation for the agreement's impact to its local workforce. F-35 officials decided to take a different approach, in line with the program's goal to control costs, to avoid offset arrangements and promote competition as much as possible. Consequently, all partner nations have agreed to compete for work on a "best-value" basis and have signed the PSFD MOU.

[30] U.S., U.K. Sign JAST Agreement. *Aerospace Daily*, December 21, 1995: 451.

[31] BAE is a major partner to Lockheed Martin and is providing the aft fuselage, empennage, and electronic warfare suite for the aircraft. Rolls-Royce is partnered with GE on the F136 engine and is a subcontractor to Pratt and Whitney for producing components for the F-35B's STOVL lift system. In November 2007, it was reported that Rolls Royce was planning to open a new plant in Virginia in 2009 to make parts for the F136 engine. (John R. Blackwell, "New Plant To Add 170 Jobs," *Richmond Times-Dispatch*, November 21, 2007.) Rolls Royce's 2001 contract with Pratt and Whitney for design and development of the STOVL lift components is valued at $1 billion over 10 years. ("Rolls-Royce Finishes First JSF Propulsion System Flight Hardware," Rolls-Royce Media Room, available online at http://www.rolls-royce.com/media/showPR.jsp?PR_ID=40243.) All F-35Bs, regardless of what engine they use, are to employ Rolls Royce components in their STOVL lift systems.

[32] "Norway Signs Industrial Partnership with Eurofighter Consortium," *Defense Daily*, January 29, 2003. Joris Janssen Lok, "Frustration Mounts Among JSF Partners," *Jane's Defence Weekly*, March 24, 2004; Thomas Dodd, "Danish Companies Consider Quitting JSF Programme," *Jane's Defence Weekly*, January 9, 2004. Tom Kingston, "Unsatisfied Italy May Cut JSF Participation," Defense News, May 10,2004. Lale Sariibrahimoglu, "Turkey may withdraw from JSF program," Jane's Defence Weekly, November 10, 2004.

[33] Tom Kington, "Italy Pushes for Europeanized JSF." *Defense News*, October 13, 2008.

[34] "F-35 International Program Content," JSF Joint Program Office paper, March 4, 2008.

[35] Ibid.

Following UK expressions in early 2006 of frustration regarding technology sharing,[36] Congress included a provision (Section 233) in the FY2007 defense authorization act (H.R. 5122/P.L. 109-364 of October 17, 2006) expressing the sense of the Congress that the Secretary of Defense should share JSF technology between the U.S. and UK governments consistent with the national security interests of both nations.[37] Program officials state that they are working with partner nations to improve their ability to effectively compete for JSF work and are working with DOD expedite technology-transfer issues.[38] Continued UK concerns about the issue were reported in August 2009.[39]

Cost and Funding

Sources of Funding

The F-35 program receives (or in the past received) funding from

- the Air Force, Navy, and Defense-Wide research, development, test, and evaluation (RDT&E) accounts;[40]
- Non-Treasury Funds (i.e., financial contributions from the eight other countries participating in the F-35 program)—a source of additional research and development funding;
- the Air Force and Navy aircraft procurement accounts;[41] and
- the Air Force MilCon account and the Navy and Marine Corps MilCon account.

Total Program Acquisition Cost

As of December 31, 2007, the total estimated acquisition cost (the sum of development cost, procurement cost, and military construction [MilCon] cost) of the F-35 program in constant (i.e., inflation-adjusted) FY2009 dollars was about $246 billion, including about $47.1 billion in

[36] The UK's top defense procurement official reportedly stated in 2006 that his country would cease participation in the F-35 program if the F136 engine were cancelled and technology transfer issues were not resolved to the UK's satisfaction. (Megan Scully, "British Demand Better Access To Fighter." *National Journal's Congress Daily AM*, March 15, 2006. George Cahlink. "U.K. Procurement Chief Warns Backup Engine Dispute Threatens JSF Deal." *Defense Daily*, March 15, 2006.)

[37] The text of the provision is as follows:

> SEC. 233. SENSE OF CONGRESS ON TECHNOLOGY SHARING OF JOINT STRIKE FIGHTER TECHNOLOGY.
>
> It is the sense of Congress that the Secretary of Defense should share technology with regard to the Joint Strike Fighter between the United States Government and the Government of the United Kingdom consistent with the national security interests of both nations.

[38] Eric Tegler, "International Instrument: Building the F-35 In Partnership," *F-35 Lightning II Commemorating First Flight*, p. 81.

[39] Amy Wilson, "F35 Jet Raises Tensions With US Over Technology Sharing," *London Sunday Telegraph*, August 30, 2009: B7.

[40] The Defense-Wide RDT&E funding occurred in FY1996-FY1998.

[41] The Navy and Marine Corps are organized under the Department of the Navy, and Marine Corps aircraft development and procurement costs are funded through the Navy's RDT&E and aircraft procurement accounts.

research and development costs, about $198.4 billion in procurement costs, and about $496 million in MilCon costs.[42]

In then-year dollars (meaning dollars from various years that are not adjusted for inflation), the figures from the preceding paragraph become $298.8 billion in acquisition costs, including $44.4 billion in research and development costs, $254.0 billion in procurement costs, and about $521 million in MilCon costs.

Since 2002, the total estimated acquisition cost of the F-35 program has increased by roughly $100 billion due primarily to a one-year extension in the program's SDD phase, a corresponding one-year delay in the start of procurement (from FY2006 to FY2007), revised annual quantity profiles, and revised labor and overhead rates. Much of this increased cost and schedule slippage was incurred to address weight-driven performance issues in the development of the F-35B.

A July 30, 2009, press report states:

> Lockheed Martin briefed U.S. Defense Department cost estimators July 29 as they reassess projections for the F-35 amid concerns that continued disagreement between higher independent and lower program office development cost figures could spell trouble for the Joint Strike Fighter.
>
> Officials from the Pentagon's Office of Program Analysis & Evaluation, Cost Analysis Improvement Group and Joint Estimating Team (JET) were to be briefed on progress with the development program July 29 at Lockheed's plant here, F-35 Program General Manager Dan Crowley said at the July 28 rollout of the first U.S. Navy F-35C variant.
>
> The previous JET report estimated development would cost an additional $5 billion and take two more years to complete than estimated by the Joint Program Office (JPO) in 2008. The team cited engineering destaffing, manufacturing span times, software development and flight-test productivity as drivers of expected cost and schedule growth.
>
> Because of delays in flying test aircraft, JSF Program Executive Officer Brig. Gen. David Heinz does not expect the updated assessment to change the JET estimate by much. But Crowley hopes to convince the independent estimators that destaffing, manufacturing and software is on track to deliver the JPO's lower projections.
>
> "The JET has been tasked with updating its assessment in September," Heinz says. "Without significant flight-testing, I do not expect a major revision."
>
> While it has been budgeting F-35 development at the lower cost estimated by the JPO, for fiscal 2010 the Pentagon opted for the JET's higher estimate and added $480 million to the budget to cover projected cost growth in flight-test.
>
> This raises the specter of a major cost jump for the development program, and potential cuts to aircraft procurement numbers, if the Pentagon abandons the JPO estimate and embraces the JET projections.

[42] The procurement cost figure of about $198.4 billion does not include the cost of several hundred additional F-35s that are to be procured other countries that are participating in the F-35 program. The $198.4-billion figure does, however, assume certain production-cost benefits for DOD aircraft that result from producing these several hundred additional F-35s for other countries.

> Crowley continues to hope the Pentagon and Congress will give the JSF program another year or two to prove its projected improvements in flight-test productivity over legacy fighter development efforts.
>
> With 99 percent of drawings released for all three variants, engineering destaffing is "following a profile close to predictions," he says, with the numbers working on the program expected to be cut from 4,000 to around 2,000 by year's end.
>
> Flight-test aircraft are between two and four months behind schedule, "but we are seeing rapid reductions in span times" as it begins assembling the first low-rate initial production aircraft, he says.
>
> While the JET assessment expected growth in the amount of software needed and doubted the industry team could meet its software productivity targets, Crowley says software content is stable and productivity is beating estimates.
>
> With only around 100 of a planned 5,000 development sorties expected to be accumulated by year's end, flight-testing remains the biggest cost and schedule challenge. "It's still difficult to estimate," Heinz says.
>
> Crowley says the team will not have enough data to support its flight-test productivity projections until it has completed 10 percent of planned sorties, expected late in 2010. "It's too early to prove them wrong," he says.[43]

Prior-Year Funding

Through FY2009, the F-35 program has received a total of roughly $44 billion funding in then-year dollars, including roughly $37 billion in research and development funding, about 6.9 billion in procurement funding, and roughly $150 million in MilCon funding.

Unit Costs

The F-35 program as of December 31, 2007 had a program acquisition unit cost (or PAUC, meaning total acquisition cost divided by the 2,456 research and development and procurement aircraft) of about $100.1 million in constant FY2009 dollars, and an average procurement unit cost (or APUC, meaning total procurement cost divided by the 2,443 production aircraft) of about $81.2 million in constant FY2009 dollars. Between October 2001 and December 2007, the constant-dollar PAUC and APUC figures have each grown by about 38%.

Manufacturing Locations

Current plans call for the F-35 to be manufactured in several locations. Lockheed will build the aircraft's forward section in Fort Worth, TX. Northrop will build the mid-section in Palmdale, CA, and the tail will be built by BAE Systems in the United Kingdom. Final assembly of these

[43] Graham Warwick, "Pentagon Reassessing F-35 Development Cost Estimates," *Aerospace Daily & Defense Report*, July 30, 2009: 1. See also Jason Sherman and Marcus Weisgerber, "Obama Administration Directs Update Of JSF JET Estimate," *Inside the Navy*, August 3, 2009; Dan Taylor, "Crowley: JET Will Meet With Lockheed In Fall To Discuss JSF Issues," *Inside the Navy*, August 3, 2009; Bob Cox, "F-35 Is On Track, Says Pentagon Officer," *Fort Worth Star-Telegram*," August 18, 2009: 1C.

components will take place in Fort Worth. Italy in 2007 reportedly was working with Lockheed and the F-35 program office on the potential of establishing a second final assembly and checkout facility in Italy.[44]

As mentioned earlier (see "Alternate Engine Program"), the Pratt and Whitney F135 engine for the F-35 is produced in Pratt and Whitney's facilities in East Hartford and Middleton, CT. The General Electric/Rolls-Royce team developing the F136 alternate engine for the F-35 includes GE Transportation—Aircraft Engines of Cincinnati, OH, and Rolls-Royce PLC of Bristol, England, and Indianapolis, IN.

Proposed FY2010 Budget

FY2010 Funding Request

Table 2 shows the administration's FY2010 request for Air Force and Navy research and development and procurement funding for the F-35 program, along with FY2008 and FY2009 funding levels. The funding figures shown in the table do not include procurement funding for initial spares, MilCon funding, or research and development funding provided by other countries.

Table 2. FY2010 Funding Request for F-35 Program

(Figures in millions of then-year dollars; FY2008 and FY2009 figures shown for reference; figures shown do not include procurement funding for initial spares, MilCon funding, or research and development funding provided by other countries;)

	FY2008		FY2009		FY2010 (request)	
	Funding	Quantity	Funding	Quantity	Funding	Quantity
RDT&E funding						
Air Force	1,939.1	—	1,734.3	—	1,858.1	—
Dept. of Navy	1,848.9	—	1,744.6	—	1,741.3	—
Subtotal	3,788.0	—	3,478.9	—	3,599.4	—
Procurement funding						
Air Force	1,412.1	6	1,660.6	7	2,349.4	10
Dept. of Navy	1,223.6	6[a]	1,650.1	7[b]	4,478.0	20[c]
Subtotal	2,635.7	12	3,310.7	14	6,827.5	30
TOTAL	6,423.7	12	6,789.6	14	10,426.9	30

Source: Prepared by CRS based on DOD data. Figures shown do not include procurement funding for initial spares, MilCon funding,, or research and development funding provided by other countries. Air Force funding for initial spares was $69.8 million in FY2008 and $60.9 million in FY2009, and $129.7 million is requested for FY2010. Department of the Navy funding for initial spares was zero in FY2008 and $32.7 million in FY2009, and $249.0 million is requested for FY2010. International partner funding for research and development was $552.7 million in FY2008 and $250.6 million in FY2009, and is projected to be $114.1 million in FY2010.

[44] Michael Sirak, "F-35 Program May Get First International Orders In Third Production Lot in 2009," *Defense Daily International*, June 22, 2007.

a. All 6 aircraft are F-35Bs for the Marine Corps.

b. All 7 aircraft are F-35Bs for the Marine Corps.

c. Includes 16 F-35Bs for the Marine Corps and 4 F-35Cs for the Navy.

The 10 F-35As requested for FY2010 in the Air Force budget have an estimated procurement cost of $2,220.3 million, or an average of $222.0 million each. These aircraft have received $171.4 million in prior-year advance procurement (AP) funding, leaving another $2,048.8 million to be funded in FY2010 to complete their estimated procurement cost. The FY2010 Air Force procurement funding request for the F-35 program also includes $300.6 million in advance procurement funding for 27 F-35As to be procured in future years, and $129.7 million for F-35A initial spares, bringing the total FY2010 Air Force procurement funding request for the program to $2,479.1 million. (**Table 2** does not include funding for initial spares, which is why it shows a total of $2,349.4 million.)

The 16 F-35Bs and four F-35Cs requested for FY2010 in the Department of the Navy budget have a combined estimated procurement cost of $4,212.1 million, or an average of $210.6 million each. These aircraft have received $215.0 million in prior-year AP funding, leaving another $3,997.0 million to be funded in FY2010 to complete their estimated procurement cost. The FY2010 Department of the Navy procurement funding request for the F-35 program also includes $481.0 million in advance procurement funding for F-35Bs and Cs to be procured in future years, and $249.0 million for F-35A initial spares, bringing the total FY2010 Air Force procurement funding request for the program to $4,727.0 million. (**Table 2** does not include funding for initial spares, which is why it shows a total of $4,478.0 million.)

Proposed Termination of Alternate Engine

The administration's proposed FY2010 budget proposes terminating the F-35 alternate engine program.

Issues for Congress

Alternate Engine Program

A key issue for Congress for the F-35 program in FY2010 is the administration's proposal to terminate the F-35 alternate engine program. As mentioned earlier, the F-35 alternate engine program is developing the General Electric/Rolls-Royce F136 engine as an alternative to the Pratt and Whitney F135 engine that currently powers the F-35. As also mentioned earlier, the George W. Bush administration proposed terminating the alternate engine program in FY2007, FY2008, and FY2009, but Congress rejected these proposals and provided funding, bill language, and report language for the program's continuation.

Summary of Arguments

Supporters of the administration's proposal to terminate the alternate engine program argue the following:

- Development, testing, and production of the F135 have reached the point where it is no longer necessary to hedge against the possibility of technical problems in the F135 engine by pursing an alternate engine program as a backup. The causes of F135 test failures in 2007 and 2008 have been identified and fixes are being implemented.
- Developing and procuring a second engine for the F-35 would add billions of dollars to the cost of the F-35 program by doubling engine development costs and halving engine production economies of scale. Such an increase in costs would reduce the number of F-35s that could be procured within a given total amount of F-35 acquisition funding. An official from the F-35 program office stated that the reduction in F-35 procurement over the next five years might total 50 to 80 aircraft.[45]
- Procuring a second engine for the F-35 would increase F-35 life-cycle operation and support (O&S) costs by requiring DOD to maintain two F-35 engine maintenance and repair pipelines.
- Having a second engine is not needed to sustain international interest in the F-35, because the most significant potential foreign buyers are already committed to the F-35 program, and because committed and potential buyers already have several significant reasons to be interested in the F-35, starting with the aircraft's capabilities, procurement cost, and operating and support cost.

Opponents of the administration's proposal to terminate the alternate engine program argue the following:

- The administration's proposal to terminate the alternate engine program does not comply with Section 213 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181 of January 28, 2008), which states: "Of the funds appropriated pursuant to an authorization of appropriations or otherwise made available for fiscal year 2008 or any year thereafter, for research, development, test, and evaluation and procurement for the Joint Strike Fighter Program, the Secretary of Defense shall ensure the obligation and expenditure in each such fiscal year of sufficient annual amounts for the continued development and procurement of 2 options for the propulsion system for the Joint Strike Fighter in order to ensure the development and competitive production for the propulsion system for the Joint Strike Fighter."
- Given that F-35s in the future are to constitute the vast majority of the country's strike fighters, and in light of F135 test failures in 2007 and 2008, it would be imprudent to have all those strike fighters powered by a single type of engine, since a problem with that engine could force the grounding of the entire F-35 fleet.
- Having a second engine in production (or ready for production) would permit DOD to use competition (or the threat of competition) in procuring and supporting F-35 engines, which will reduce F-35 engine procurement and O&S costs compared to what would be achievable in a sole-source procurement,

[45] Graham Warwick and Guy Norris, "Second Engine Could Force F-35 Production Cuts, PEO Warns," *Aerospace Daily & Defense Report*, June 1, 2009: 3.

offsetting the additional costs associated with developing, procuring, and supporting a second engine. Competition (or the threat of competition) would also promote better engine performance, increased engine reliability, and improved contractor responsiveness. Having two F-35 production lines in operation would also permit F-35 engine production to be more quickly surged to higher levels if needed to respond to a change in the strategic environment, and preserve a potential for maintaining effective competition in the development and procurement of future tactical aircraft engines, particularly if F-22 and F/A-18E/F production ends.

- Having a second engine in production would help sustain international interest in the F-35 program, maximizing F-35 exports. Potential foreign buyers would be more inclined to purchase the F-35 if they had a choice regarding the aircraft's engine.[46]

Administration Perspectives

Office of Management and Budget

An Office of Management and Budget (OMB) document on proposed FY2010 program terminations, reductions, and savings states that:

> The Administration has decided not to fund the Joint Strike Fighter (JSF) Alternative Engine Program (AEP), because it is no longer needed as a hedge against the failure of the main Joint Strike Fighter engine program. The Department of Defense (DOD) proposed cancelling the JSF AEP in the President's 2007 Budget because development of the main engine was progressing well and analysis indicated that savings from competition would not be offset by high upfront costs. DOD did not request funding for the program in the 2008 and 2009 Budgets. However, the Congress has rejected the proposed cancellations and has added funding each year since 2007 to sustain the AEP development....
>
> Because DOD wanted to reduce technical risk in the development of the JSF engine, the Department has had two contractors developing separate JSF engines. However, in 2007, DOD proposed to cancel the contract for the second (alternate) engine because the main engine program was progressing well, making a second engine program unnecessary. Moreover, financial benefits, such as savings from competition, have been assessed to be small, if they exist at all, because of the high cost of developing, producing and maintaining a second engine. The reasons for canceling the AEP in 2007 remain valid today. Studies by both the Government Accountability Office and Congressional Budget Office have questioned the affordability of the current defense program, particularly the high cost of

[46] Opponents of terminating the alternate engine might argue that having two engine types available would enhance foreign sales of the F-35 because it would give foreign buyers more flexibility in choosing which engine to use (which can be of value to them for political purposes), and because foreign buyers may conclude that the competition between the two engine markers is helping to restrain the engine portion of the aircraft's total cost. A 2006 article quotes one observer as stating that "The F-16 became a much more exportable aircraft when GE and Pratt were killing each other in the international market. So, if you are selling these JSF's and you have got one engine ... that reduces the attractiveness to these international customers ... " (Carlo Munoz. "Congress, Defense Department Square Off Over Second JSF Engine." *Inside the Air Force.* March 3, 2006.)

modernizing tactical aviation.[47] Canceling the AEP will result in estimated near-term savings of over a billion dollars.[48]

DOD Testimony at May 20, 2009, Hearing

At a May 20, 2009, hearing before the Air and Land Forces subcommittee of the House Armed Services Committee on Air Force acquisition programs, a DOD acquisition official stated:

> The F-35 acquisition strategy contains provisions for a competitive engine program, provided funds are available to execute that strategy. Currently, the F135 engine is completing the development phase and beginning initial low rate production to support the F-35 aircraft production and test schedule. The F135 experienced two separate low pressure turbine blade failures, the first in the September 2007 and the second in February 2008. Root cause analysis determined the problem. The appropriate fixes were identified and are being incorporated into the remaining test and all future production engines. The engines were certified for Short Take-Off and Vertical Landing testing in January 2009, and the program recently completed hover pit testing as it prepares for full vertical landing flight tests later this year.
>
> The Department did not include funding in the Fiscal Year 2010 President's Budget for the F136 competitive engine. The decision to not include funding for the F136 is consistent with the Department's position on this issue for the prior three budget submissions. The decision this year was reviewed by the Department's leadership as well as the Administration. The determination of whether to fund the competitive engine, as it has in the past, was weighed against the budget priorities of the Department as a whole, the optimum use of taxpayer's dollars in executing and preparing for the National defense, and the benefits to the F-35 program. The Department continues to execute appropriated development funding to ensure that a competitive engine program remains viable while there is funding is available. Since there is no follow-on procurement funding in Fiscal Year 2010, the Department has delayed execution of advance procurement funding appropriated in the Fiscal Year 2009 Appropriations Act. The Department's policy is to execute advance procurement funds only when associated follow-on procurement funding or a programmed plan that contains full procurement funding is available.[49]

At the same hearing, Air Force officials stated the following:

> Presidential Budget 10, released earlier this month, cancelled the alternate engine program for the Joint Strike Fighter, and removed all further funding for the development and procurement of this second engine. The Air Force and Navy are executing the funding appropriated by Congress in the 2009 budget to continue the F136 program.
>
> The cost to continue F136 engine development is approximately $1.8B through FY15. In addition, the Department of Defense will have to fund the production of GE engines to get

[47] The passage at this point has a footnote citing the following two reports: Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-09-326SP, March 2009; and Congressional Budget Office, *Long Term Implications of the Fiscal Year 2009 Future Years Defense Program*, January 2009.

[48] Office of Management and Budget. *Terminations, Reductions, and Savings, Budget of the U.S. Government, Fiscal Year, 2010*. Washington, May 2009. p. 38.

[49] Statement of Mr. David G. Ahern, Director, Portfolio Systems Acquisition, Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics), Before the House Armed Services Committee Subcommittee on Air and Land Forces, May 20, 2009, pp. 6-7.

> the suppliers on equal footing in the amount of approximately $2.8B. Continued funding for the F136 engine carries cost penalties to both F135 and F136 engines for reduced production line learning curves and inefficient economic order quantities. The department has concluded that maintaining a single engine supplier provides the best balance of cost and risk. Our belief is the risks associated with a single source engine supplier are manageable due to improvements in engine technology and do not outweigh the investment required to fund a competitive alternate engine.[50]

F-35 Program Executive Officer (PEO)

A June 1, 2009, press report states:

> Funding development of a second engine from within the existing F-35 budget would cut production by dozens of aircraft and push up program costs, the Joint Strike Fighter's program chief warns in an interview with Aviation Week.
>
> The concerns come as Congress is expected to reverse the White House and Pentagon's effort to cancel the alternate powerplant.
>
> Forcing the program to fund development of the General Electric/Rolls-Royce F136 from within the existing JSF budget would "take 50-80 tails out of the program" over the next five years, says the program executive officer (PEO), Marine Corps Brig. Gen. David Heinz.
>
> The Defense Department's fiscal 2010 budget request calls for procurement of 513 F-35s over five years, an increase of 25 over previous plans, with another 180 expected to be built for international partners over the same period. This would take annual production "into the low 200s" by FY '15, he says.
>
> Funding the F136 within the existing budget would require cutting six aircraft from the 30 planned in FY '10, Heinz says. This would make aircraft in subsequent years more expensive, pushing back international purchases and compounding the problem because the partners could not afford early aircraft, he says.
>
> "We would never get to 200 tails [a year]. We would build out to around 100, under-utilize the tooling and not get down the learning curve," the PEO says. "I worry about taking tails out of the program because it will get so expensive the partners will start to pull back."
>
> Pentagon leadership has not sought to continue the F136, arguing DOD can only afford the Pratt & Whitney F135 primary engine. But Congress is expected to reinstate the funding. Lawmakers, with widespread consensus, have ignored the cancellation effort for years and earmarked money for the alternate.
>
> But before, some of the restored funding has come from within the existing JSF budget, forcing cuts elsewhere in the program. Former U.S. Air Force leaders have testified on Capitol Hill that they didn't so much oppose an alternate engine as they did sacrificing elsewhere to fund it (Aerospace DAILY, March 7, 2008).

[50] Department of the Air Force Presentation to the House Armed Services Committee Subcommittee on Air and Land Forces, United States House of Representatives, Subject: Air Force Programs, Combined Statement of: Lieutenant General Daniel J. Darnell, Air Force Deputy Chief Of Staff For Air, Space and Information Operations, Plans And Requirements (AF/A3/5) [and] Lieutenant General Mark D. Shackelford, Military Deputy, Office of the Assistant Secretary of the Air Force for Acquisition (SAF/AQ) Lieutenant General Raymond E. Johns, Jr., Air Force Deputy Chief of Staff for Strategic Plans And Programs (AF/A8) May 20, 2009, p. 11.

> The GE/R-R Fighter Engine Team has defended its lobbying for the F136. "We've never advocated taking the money out of the other parts of the program. Congress needs to decide where the money comes from," says Dennis Jarvi, president of Rolls-Royce North America Defense.
>
> The international partners would like a competing engine, and Pentagon efforts to kill the F136 are "sure to be a major topic" when they meet in Washington later this month, says Tom Burbage, Lockheed executive vice-president and general manager, F-35 program integration. "There is support in the international community for the second engine," he tells Aviation Week.
>
> Burbage says the second-engine issue is "programmatically complex" because, while Congress has incrementally funded development of the F136, the Defense Dept. has not factored production of two engines into its budget planning and not decided how it would conduct an annual leader/follower competition.
>
> "It's the clear intent of Congress to have a second engine, but it could have a very substantial impact," he says.[51]

A June 3, 2009, press report states:

> The top Joint Strike Fighter official says he unequivocally supports President Barack Obama's fiscal 2010 budget request, which does not seek funds for a second JSF engine—but he is still planning for the F136 and suggests Washington consider the risk otherwise.
>
> Citing the potential for "competitive advantage" from alternate engines for the single-engine F-35, and noting that there could be an operational risk some day from having just one engine, Marine Corps Brig. Gen. David Heinz told reporters at the JSF Joint Program Office June 2 that there might be considerations beyond the financial cost of funding dual powerplant efforts.
>
> "Do we still believe that's acceptable?" Heinz asked rhetorically.
>
> Meantime, the general—selected for his second star after his promotion from deputy program chief—says it would be irresponsible for him not to plan for both engine efforts. "I have to," he asserts, adding it would be "downright reckless" not to after Congress has earmarked funds for the second engine several times already. And besides, military officials spend a lot of their time planning for things that do not happen, he joked.
>
> Heinz explained to the roundtable of reporters that funding development of a second engine from within the existing F-35 budget would cut production by 50 or more aircraft and push up program costs—a point he made to Aviation Week last week (Aerospace DAILY, May 29). But the program executive officer also stressed that economic modeling was difficult, and that a competition for the engines would likely drive down costs.
>
> Heinz further asserted that the primary Pratt & Whitney F135 engine has yet to truly compete with the General Electric/Rolls-Royce F136, regardless of what Pratt and some supporters may suggest.

[51] Graham Warwick and Guy Norris, "Second Engine Could Force F-35 Production Cuts, PEO Warns," *Aerospace Daily & Defense Report*, June 1, 2009: 3.

> Assuming the program's planned ramp-up and a 50-50 split engine order during the sixth low-rate initial production tranche, fiscal 2013 would be the first genuine year of the rivalry. Such a race could bring technology advancements too, the general notes. "They are just beginning in that competition," he says.[52]

A June 8, 2009, press report states:

> The new general in charge of the F-35 Joint Strike Fighter program last week told reporters the Defense Department must weigh the operational risks of having a single engine program for the fifth-generation jet rather than solely looking at the cost implications of procuring two power plants.
>
> The F-35 Lightning II was conceived to be developed with two engines, the Pratt & Whitney F135 and the General Electric-Rolls-Royce F136. However, DOD in recent years—including in its budget request for fiscal year 2010—has zeroed funding for the second power plant.
>
> Each year, Congress has reintroduced full funding for the F136 in its markups of the defense budget. "I support the president's budget, but in the future, should there be an engine incident on the F135 motor, our ability to absorb an incident that may ground a large number of those motors ... is going to lessen," Marine Corps Brig. Gen. David Heinz said during a June 2 briefing at the JSF program office in Arlington, VA, noting that the F-35 will eventually replace a number of legacy jets, including the F-15 Eagle, the F-16 Viper, the F/A-18 Hornet and the AV-8B Harrier II.
>
> As such, the military will not have the operational flexibility it has today if an engine problem leads to the grounding of the F-35 fleet with a single engine, Heinz added.
>
> "I believe part of the debate that has to occur and is occurring is, 'Is there an operational risk that we are accepting by having just one engine manufactured?'" he said. "I simply think we focus too much on the discussion about cost benefit and not operational risk benefit."
>
> Heinz also continued the rhetoric of his predecessor—Air Force Maj. Gen. Charles Davis—that the true cost savings of having two engines competing in the program have yet to be revealed. In the 1980s engine wars, per-unit costs reductions reached 20 percent due to competition, he noted.
>
> "I think that, because of the difference in the development time line, that [the competition] has not yet occurred," the Marine Corps one-star said. "Pratt is not truly competing with GE yet for the market share, because I only have Pratt engines through [low-rate initial production]-3. We're going to introduce—if Congress fully funds in the [fiscal year 2010] budget—four GE motors, but that's four out of 30 motors that we'll buy next year, so they're just beginning in that competition. I do not believe yet that Pratt feels compelled as though they are in competition with GE."
>
> DOD last week awarded JSF prime contractor Lockheed Martin a $2 billion contract to produce 17 LRIP-3 F-35s. The lot includes the first international orders—two operational test aircraft for the United Kingdom and one for the Netherlands. In March and April, Lockheed received $306 million to prepare production for 32 LRIP-4 aircraft. When the competition truly heats up between Pratt and the GE-Rolls-Royce Fighter Engine team, Heinz said there will be "much more technology push" between the two, because they will

[52] Michael Bruno, "JSF Program Chief Cites Advantages Of Competing Engines," *Aerospace Daily & Defense Report*, June 3, 2009: 1-2.

be striving to win more engine buys. The two companies also will try to introduce such innovations as more efficient blades, fuel savings and thrust growth capability.

Late last month, team officials told reporters there is a "strong business case" to continue the second engine program, and it will cost roughly $130 million—compared to the $100 billion total for F-35 engine production—to open the F136 production line.

Further, international partners including the United Kingdom entered into the JSF program with the expectation that there will be two engines, they contended. If Congress directs the JSF program office to continue the F136 program, then Heinz will introduce the first four GE-Rolls-Royce power plants into the F-35's fourth low-rate initial production lot, the Marine Corps general said. The engine buys will then ramp up to the point where there will be a 50-50 split in engine procurement by LRIP-6.

"That would also allow the GE motor to be in operation for about a year in the fleet so I now have both costing data, I've got them to about the same point in quantities, and I've got operational experience with both motors," Heinz said. "At that point, the services and the [Joint Program Office] have pretty good information to start competition and to start the competitive nature to start to drive how much quantity I buy in the next years following that."

The true competition, by Heinz's calculations, will begin in FY-13, he said.

Adding that it would be "reckless" not to plan for the possibility of F136 congressional funding, Heinz said the Office of the Secretary of Defense should release advance procurement funding for the second engine if Congress shows their commitment to the program in its markup of the FY-10 budget. Though such funding has been appropriated in previous years' budgets, none of the money thus far has gone to the program office. [53]

Chief of Naval Operations (CNO)

A July 29, 2009, press report states:

> The U.S. Navy has strongly endorsed a single engine for the Lockheed Martin F-35 Joint Strike Fighter, citing lack of space on its aircraft carriers to support an alternate powerplant.
>
> "I'm in the one engine camp," said Chief of Naval Operations Adm. Gary Roughead, speaking July 28 at the rollout of the first Pratt & Whitney F135-powered F-35C carrier variant here. "On a carrier, space matters."[54]

Secretary of Defense

An August 24, 2009, press report states:

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[53] Jason Simpson, "Heinz: DOD Must Look At Operational Risks of Having One JSF Engine," *Inside the Navy*, June 8, 2009.

[54] Graham Warwick, "Navy Backs Single JSF Engine As F-35C Rolls Out," *Aerospace Daily & Defense Report*, July 29, 2009: 1-2. See also Marcus Weisgerber and Dan Taylor, "Top JSF Official's Comments Could Help Fight For G.E.-Rolls Engine," *Inside the Air Force*, July 31, 2009; Antonie Boessenkool, "Pratt & Whitney's Costs Parts-Reject Rate Too High: JSF Official," *Defense News*, August 3, 2009: 14; Dan Taylor, "Heinz: Pratt Can 'Do Better' On F135; Company Defends Engine," *Inside the Navy*, August 3, 2009.

> Responding to 24 percent cost growth in the Pratt & Whitney engine being readied for the F-35 Joint Strike Fighter, Defense Secretary Robert Gates brushes off the question by saying "there is always cost growth associated with a developmental aircraft. It's one of the reasons we have over $4 billion in the FY '10 budget to reduce the program risk [by allowing] for more engineers, more testing time, more airframes for testing. We think that fixing the problems we've encountered ... with the engine is something that's quite manageable. And we don't think it's the best use of our money to fund a second engine." The Pentagon is looking a fixed-price contract to avoid production cost overruns. "That's something we would like to have a look at," says Marine Gen. James Cartwright, vice chairman of the Joint Chiefs of Staff.[55]

Au August 31, 2009, press report states:

> Defense Secretary Robert Gates today continued to defend his assessment that the Joint Strike Fighter second engine program is not a worthwhile investment.
>
> Following a tour of F-35 Lightning II prime contractor Lockheed Martin's Fort Worth, TX, facilities, Gates added that he believes the General Electric-Rolls-Royce F136 power plant—the alternate engine—would most likely experience the same development problems the Pratt & Whitney F135 propulsion system has encountered in recent years.
>
> "There's no reason to believe that it would not encounter the same kinds of development challenges that other new engines have encountered along the way," Gates said, repeating a "general conclusion" that the second engine would add "several billion dollars" to the total JSF price tag. "At this point, where we're trying to count every dollar and where a dollar ... added to one program takes away from another program that we think is important, we feel strongly about the fact that there is not a need for a second engine."[56]

GAO And Other Perspectives

GAO

At a May 20, 2009, hearing before the Air and Land Forces subcommittee of the House Armed Services Committee on Air Force acquisition programs, GAO testified on the F-35 program, stating in the testimony's summary that:

> The department [i.e., DOD] has not asked for funding for the alternate engine program in the budgets since 2007 arguing that an alternate engine is not needed as a hedge against the failure of the main engine program and that the savings from competition would be small. Nonetheless, the Congress has added funding each year since then to sustain its development. Our prior analysis indicates that competitive pressures could yield enough savings to offset the costs of competition over the JSF program's life. To date, the two contractors have spent over $8 billion on engine development—over $6 billion with the main engine contractor and over $2 billion with the second source contractor.[57]

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[55] "No Means No," *Aerospace Daily & Defense Report,* August 24, 2009: 1. Ellipsis as in original.

[56] Jason Simpson, "Gates: 'No Reason to Believe' F136 Would Not Encounter Same Problems as F135," *InsideDefense.com DefenseAlert – Daily News,* August 31, 2009.

[57] Government Accountability Office, *Joint Strike Fighter[:]Strong Risk Management Essential as Program Enters Most Challenging Phase, Statement of Michael Sullivan, Director Acquisition and Sourcing Management*. GAO-09-711T, May 20, 2009, summary page.

Elaborating on this summary statement, the testimony stated the following:

> **DOD's Proposal to Cancel the Alternate Engine Program May Bypass Long-term Merits**
>
> DOD and the Congress have had a continuing debate for several years on the merits of an alternate engine program to provide a second source and competition for engine procurement and life cycle support. The alternate engine program was part of the original JSF acquisition strategy. The department first proposed canceling the alternate engine program in the 2007 budget and has not asked for funding in the budgets since then. The administration does not believe an alternate engine is needed as a hedge against the failure of the main engine program and believes savings from competition would be small. The Congress has added funding each year since 2007 to sustain the alternate engine development, including $465 million for fiscal year 2009. To date, the two contractors have spent over $8 billion on engines development—over $6 billion with the main engine contractor and over $2 billion with the second source contractor.
>
> The way forward for the JSF engine acquisition strategy entails one of many critical choices facing DOD today, and underscores the importance of decisions facing the program. As we noted in past testimonies before this committee, the acquisition strategy for the JSF engine must weigh expected costs against potential rewards. In each of the past 2 years we have testified before this committee on the merits of a competitive engine program for the Joint Strike Fighter.[58] While we did not update our analysis we believe it is still relevant and the same conclusions can be drawn. We reported in 2008 that to continue the JSF alternate engine program, an additional investment of about $3.5 billion to $4.5 billion in development and production-related costs, may be required to ensure competition.[59] Our earlier cost analysis suggests that a savings of 9 to 11 percent would recoup that investment. As we reported last year, a competitive strategy has the potential for savings equal to or exceeding that amount across the life cycle of the engine. Prior experience indicates that it is reasonable to assume that competition on the JSF engine program could yield savings of at least that much. As a result, we remain confident that competitive pressures could yield enough savings to offset the costs of competition over the JSF program's life. However, we recognize that this ultimately will depend on the final approach for the competition, the number of aircraft actually purchased, and the ratio of engines awarded to each contractor.
>
> Results from past competitions provide evidence of potential financial and nonfinancial savings that can be derived from engine programs. One relevant case study to consider is the "Great Engine War" of the 1980s—the competition between Pratt & Whitney and General Electric to supply military engines for the F-16 and other fighter aircraft programs. At that time, all engines for the F-14 and F-15 aircraft were being produced on a sole-source basis by Pratt & Whitney, which was criticized for increased procurement and maintenance costs, along with a general lack of responsiveness to government concerns about those programs. For example, safety issues with the single-engine F-16 aircraft were seen as having greater

[58] The passage at this point has a footnote citing the following two prior instances of GAO testimony: Government Accountability Office, *Joint Strike Fighter[:] Impact of Recent Decisions on Program Risks*, Statement of Michael Sullivan, Director Acquisition and Sourcing Management, Testimony before the Subcommittees on Air and Land Forces, and Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, GAO-08-569T, March 11, 2008; and Government Accountability Office, *Defense Acquisitions[:]Analysis of Costs for the Joint Strike Fighter Engine Program*, Statement of Michael Sullivan, Director Acquisition and Sourcing Management, Testimony before the Subcommittees on Air and Land Forces, and Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, GAO-07-656T, March 22, 2007.

[59] The passage at this point has a footnote stating: "Since that time, Congress appropriated $465 million in the fiscal year 2009 budget to continue the alternate engine program."

consequences than safety issues with the twin-engine F-14 or F-15 aircraft. To address concerns, the Air Force began to fund the development and testing of an alternate engine to be produced by General Electric; the Air Force also supported the advent of an improved derivative of the Pratt & Whitney engine. Beginning in 1983, the Air Force initiated a competition that Air Force documentation suggests resulted in significant cost savings in the program. In the first 4 years of the competition, when actual costs are compared to the program's baseline estimate, results included (1) nearly 30 percent cumulative savings for acquisition costs, (2) roughly 16 percent cumulative savings for operations and support costs; and (3) total savings of about 21 percent in overall life cycle costs.

The Great Engine War was able to generate significant benefits because competition incentivized contractors to improve designs and reduce costs during production and sustainment. Competitive pressure continues today as the F-15 and F-16 aircraft are still being sold internationally. While other defense competitions resulted in some level of benefits, especially with regard to contractor responsiveness, they did not see the same levels of success absent continued competitive pressures.

Similar competition for the JSF engines may also provide benefits that do not result in immediate financial savings, but could result in reduced costs or other positive outcomes over time. Our prior work, along with studies by DOD and others, indicate there are a number of nonfinancial benefits that may result from competition, including better performance, increased reliability, and improved contractor responsiveness. In addition, the long-term effects of the JSF engine program on the global industrial base go far beyond the two competing contractors.

DOD and others have performed studies and have widespread concurrence as to these other benefits, including better engine performance, increased reliability, and improved contractor responsiveness. In fact, in 1998 and 2002, DOD program management advisory groups assessed the JSF alternate engine program and found the potential for significant benefits in these and other areas. Table 2 summarizes the benefits determined by those groups.

Table 2: 1998 and 2002 Program Management Advisory Group Study Findings on the Benefits of an Alternate Engine Program

	Beneficial		Marginal		No Value	
Factor assessed	**1998**	**2002**	**1998**	**2002**	**1998**	**2002**
Costs			X	X		
Development risk reduction					X	X
Engine growth potential			X	X		
Fleet readiness	X	X				
Industrial base	X	X				
Int'l implications	X	X				
Other considerations[d]	X	X				
Overall	X	X				

Source: GAO analysis of DOD data.

d. Other considerations include contractor responsiveness, improved design solutions, and competition at the engine subsystem level.

While the benefits highlighted may be more difficult to quantify, they are no less important, and ultimately were strongly considered in recommending continuation of the alternate engine program. These studies concluded that the program would maintain the industrial base for fighter engine technology, enhance readiness, instill contractor incentives for better performance, ensure an operational alternative if the current engine developed problems, and enhance international participation.

Another potential benefit of having an alternate engine program, and one also supported by the program advisory groups, is to reduce the risk that a single point systemic failure in the engine design could substantially affect the fighter aircraft fleet. This point is underscored by recent failures of the Pratt & Whitney test program. In August 2007, an engine running at a test facility experienced failures in the low pressure turbine blade and bearing, which resulted in a suspension of all engine test activity. In February 2008, during follow-on testing to prove the root cause of these failures, a blade failure occurred in another engine, resulting in delays to both the Air Force and Marine Corps variant flight test programs. [60]

Clinton Administration DOD Acquisition Executive

A September 4, 2009, press report states:

> A former Clinton-era Pentagon acquisition executive this week told Inside the Air Force he supports a competitive dual-source F-35 Joint Strike Fighter engine program, claiming it will enhance the industrial base and create a better product from both companies....
>
> Jacques Gansler, who was the Pentagon's top weapons buyer from 1997 to 2001, said the debate regarding the General Electric-Rolls-Royce F136 engine—the proposed alternate JSF engine—has "such a close analogy to the Great Engine War; it would strike me that people would say, 'We should've learned that lesson.'" Gansler was referring to the Air Force's struggle during the 1980s over an alternate engine for the F-15 and F-16 fleets.
>
> Gansler's comments on the F136 debate comes the same week the GE-Rolls-Royce team proposed a fixed-price buying concept to the JSF Joint Program Office. Defense Secretary Robert Gates recently opined that the second JSF engine would encounter the same development problems as the primary propulsion system—the Pratt & Whitney-built F135—has endured in recent years.
>
> "What [dual sourcing] does is sustain the industrial base of two sources that can each introduce their own innovation and each have different sets of suppliers, so you can support the lower tier of two industrial sources," Gansler, who now is the director of the Center for Public Policy and Private Enterprise at the University of Maryland, in a Sept. 1 telephone interview with ITAF.
>
> Competitive dual sourcing also steepens the learning curve—or the unit cost versus quantity of a product—more so than with "monopoly pricing," where the learning curve actually goes down, Gansler claimed.

[60] Government Accountability Office, *Joint Strike Fighter[:]Strong Risk Management Essential as Program Enters Most Challenging Phase, Statement of Michael Sullivan, Director Acquisition and Sourcing Management*. GAO-09-711T, May 20, 2009, pp. 4-7.

"The rationale is always, 'Well, that's because we're getting improved performance, so therefore we're paying more for it,'" he said. "The reality is you don't have to do that if you have competition. If you have a monopoly, why would you want to make things cheaper?"

Continued Gansler: "Who do you think doesn't want it to be competed? Pratt & Whitney.... The Air Force doesn't want to pay any up-front money. That's the disadvantage of competitive dual sourcing: there are some early non-recurring costs you invest in, in order to make savings later on."

With a sole-source engine program, "you pay more and get less performance and less reliability," he said. The government will get improvements in a sole-sourced program, "but you keep paying for them."

Gansler believes the acceptable reliability of either a sole-sourced F135 or the F136 will be reached, but, "in a continuous competition, you get better and better reliability, better and better performance, at lower and lower cost."

There is a "clear analogy" between the F136 debate and the "Great Engine War" of the 1980s, when the Air Force opted to open competition to engine procurement after propulsion system reliability issues began affecting the F-15 Eagle and F-16 Viper fleets, according to Gansler. In the 1970s and 1980s, Pratt & Whitney was the sole-source supplier of the service's fighter jet power plants.

"The Air Force decided it would make sense to introduce an alternative, which didn't cost very much to develop because it was already available and being developed for another application," he said. "There's a clear analogy here because a second engine is already being developed for the Joint Strike Fighter."

When the Air Force added an alternative engine to the mix in the 1980s, the performance of both power plants went up "significantly as a result of the continuous competition, and the costs went down significantly," Gansler said. The Air Force estimated that it saved between $2 billion to $3 billion as a result of the competitive-buy structure.

Gansler is not the only former DOD official criticizing a sole-source F-35 Lightning II engine plan.

In an opinion piece originally intended to be used on an F136-related Web site, retired Marine Corps Lt. Gen. Michael Hough—former director of the JSF program—also spoke out in favor of a competitive dual-source engine acquisition strategy.

In the letter, Hough claims that there never was a true competition for the JSF primary power plant and that it is "vital" to have an alternative source. The cost of competition "in the near term is worth every penny" and healthy for the nation, he says.

"I have watched with disappointment over the last few months as those advocates of sole sourcing the F-35 with only the Pratt & Whitney engine have attempted to spin a tale of myth and innuendo to deliberately muddy the waters around the issue of competition of the ending for the F-35," Hough's letter reads. "From a war fighter's perspective, the second engine provided not only an interoperable alternative, but a 'must have' insurance policy if either engine became grounded due to design, fatigue, or other reasons."

In June, current JSF program executive officer, Marine Corps Brig. Gen. David Heinz told reporters the military's ability to "absorb" a grounding issue on the F-35 due to an engine incident would "lessen" with only one engine source (ITAF, June 5, p1). The government

needs to assess the operational risk of having only one engine for a jet that will replace four legacy fighters before canceling the program, he said.

However, the current defense secretary does not share the same view as Gansler and Hough.

Gates this week continued to defend his assessment that the second engine program is not a worthwhile investment.

Following a tour of F-35 prime contractor Lockheed Martin's Fort Worth, TX, facilities on Aug. 31, Gates added that he believes the F136 power plant would most likely experience the same development problems the Pratt & Whitney F135 propulsion system has encountered in recent years.

"There's no reason to believe that it would not encounter the same kinds of development challenges that other new engines have encountered along the way," Gates said, repeating a "general conclusion" that the second engine would add "several billion dollars" to the total JSF price tag. "At this point, where we're trying to count every dollar and where a dollar ... added to one program takes away from another program that we think is important, we feel strongly about the fact that there is not a need for a second engine."...

F136 spokesman George McLaren declined to specifically comment on Gates' assessment of the F136 program.

However, in a Sept. 1 telephone interview, McLaren said the company is "working very hard to continue to build the business care that makes the F136 attractive for the government."

McLaren cited a May Government Accountability Office report that stated a 9 percent to 11 percent savings in competition would completely pay for the F136 program's up-front costs. When the Air Force opted to dual-source engine contracts for its fighter fleet beginning in the 1980s, the savings totaled 21 percent, he said.

"We all recognize there are short-term budget issues," he said. "Our position is, if you look at the long-term, you have a potential $20 billion savings over the lifetime of the F-35 program."

The government has thus far spent $2.5 billion—70 percent of the total contract with the GE-Rolls-Royce team—on the F136 program, according to McLaren. The design has passed critical design review, and the three engines built thus far have been tested for more than 800 hours. The first flight of an F-35 with an F136 engine is scheduled for February 2011.

The only design tweak for the company's engine was a "slight adjustment" earlier this year on a bearing the team noticed during a test, McLaren said. The adjustment has been incorporated in subsequent engine builds.

In July, the White House released a statement of administrative policy that said President Obama would veto a defense spending bill that included funds for the GE-Rolls-Royce engine. His stated reasoning was that the Pratt & Whitney engine was performing well, "and the risks associated with a single engine provider are manageable."

Gansler, however, took aim at this rhetoric when discussing the issue with ITAF.

"I don't think he understands the benefits of competition in spite of the fact that he has given speeches about the importance of competition," Gansler said. "He then goes on to say, 'We have one good engine, why do we need a second one?' That's kind of saying, 'Well, I don't believe in competition.'"

> In an attempt to garner support inside the Pentagon, the GE-Rolls-Royce Fighter Engine Team this week met with JSF Joint Program Office and top Pentagon officials to offer a fixed-price buying option for F136 engines, according to McLaren. The team believes this approach could save the government millions of dollars over the lifespan of the F-35, he said.
>
> "A fixed price contract shifts the burden of risk away from the Government, and instead, risk is shared between the Government and the contractor," McLaren said in a Sept. 2 e-mail. "The government would know what its costs will be, and will be better able to contain them. The other engine program is currently $1.9 billion over budget now on its cost plus contract, according to the House Armed Services Committee. Those costs have been borne by the government."
>
> The exact number of engines and specific per-unit costs are subject to negotiation with DOD officials, he added, but the earliest orders targeted are for low-rate initial production lot 5, which has a scheduled delivery in 2013.
>
> The meeting on Sept. 1 followed informal discussions with program officials over the past several months, and there will be additional meetings "in the next several weeks," according to McLaren.
>
> "If the customer feels we have not met our business case, [then] it is our responsibility to create a new one that meets their expectations," he said. "That is what we are doing by offering fixed price contracting for our early production engines. We feel this is a 'game changing' idea with great benefits to the government, and that we are uniquely qualified to make this pitch because of our record of outstanding program execution on schedule and cost."
>
> During an Aug. 27 briefing with reporters, Acting Assistant Air Force Secretary for Acquisition David Van Buren said the service's weapons-buying community has begun discussing which of the two contract vehicles is more cost efficient for programs depending on their inherent risk. Van Buren was not specifically referencing the JSF program, but acquisition programs in general.
>
> "I think it's a dialog that we have with industry, and I think we're working to create a more business-like environment" within the U.S. military, Van Buren said.
>
> JSF program office spokeswoman Cheryl Limrick—through a Sept. 2 e-mail—declined to comment on the proposal, stating, "It would be inappropriate for us to make any comment during talks about contracts/negotiations."[61]

Remarks at June 2009 Air Show

A June 18, 2009, press report states:

> Despite the Obama administration's official desire to cancel the General Electric/Rolls-Royce (GE/RR) F136 alternate engine for the F-35 Joint Strike Fighter, the program and its customers are privately telling the manufacturers that the engine is needed.

[61] Jason Simpson, "Gansler: Military Needs Competitive Dual Sourcing For JSF Engine," *Inside the Air Force*, September 4, 2009.

> Behind this apparent contradiction, GE and RR people at the show here believe, is the fact that the F136 has more inherent power potential than the current Pratt & Whitney F135 configuration.
>
> GE program leader Jean Lydon-Rogers confirmed here, for the first time in a formal briefing, that the F136 was designed, from the start of system development and demonstration in 2004, with a bigger core and greater total airflow than was planned in the pre-SDD stage, to deal with ncreases in the JSF's weight.
>
> One result is that the engine could gain 5 percent in thrust (more than 2,000 pounds) with a simple software change. In the medium term, though, GE and RR believe that the F136 has a bigger temperature margin than the F135, allowing it to maintain performance in hot-and-high conditions.
>
> This will be important for the United Kingdom. Although the F135 is expected to meet formal key performance parameters, including the short-takeoff-and-vertical-landing F-35B's bring-back requirement for the U.S. Marine Corps, Britain's experience of Harrier operations under hot, humid and high-level conditions in Afghanistan has led to a tougher "hot day" definition. GE and RR say that the F136 can deliver more performance under those conditions.
>
> The program office and customers recognize this issue, according to people associated with the F136. The problem is that in the past (and still, with this week's action in the House of Representatives), Congress has cut aircraft from the program to pay for the F136 (Aerospace DAILY, June 17), and the program office and customers don't want to see that happen either. They want Congress to fund the F136 from other sources. Further complicating the issue is that the White House has now formally come out in favor of cutting the F136.[62]

Mandated Studies of 2007 on F-35 Alternate Engine[63]

Section 211 of the 2007 defense authorization act (H.R. 5122/P.L. 109-364 of October 17, 2006) (see **Appendix A** for text) directed three independent cost analyses of the F-35 engine program. The studies were conducted by the Cost Analysis Improvement Group (CAIG) within the Office of the Secretary of Defense (OSD), the Institute for Defense Analyses (IDA), and GAO. The studies used the same data (which were provided by the JSF program office and contractors), and were completed in 2007.

The studies came to differing conclusions regarding the estimated financial break-even points for an alternate engine program. The studies all cited non-financial benefits that would be derived from an engine competition, including improvements in fleet readiness, contractor responsiveness, sustainment of industrial base, and stronger international relations.

CAIG Study

The CAIG study examined the results of the engine competition for the Air Force F-16 fighter program (also known as the Great Engine War—see "Great Engine War" of 1984-1994" below),

[62] Bill Sweetman, "JSF Needs F136, Partners Say At Air Show," *Aerospace Daily & Defense Report*, June 18, 2009: 2.

[63] This section presents, in edited form, material from an earlier CRS report on the alternate engine program—CRS Report RL33390, *Proposed Termination of Joint Strike Fighter (JSF) F136 Alternate Engine*, by Christopher Bolkcom.

the engine competition for the Navy and Marine Corps F/A-18 strike fighter program,[64] and the sole-source procurement of the Pratt and Whitney F-119 engine for the F-22. The CAIG study noted that, in light of the CAIG's analysis of past cost performance in acquisition efforts using competition, the CAIG's baseline "assumptions [were] generally favorable to dual source case."[65] The study assumed that the second F-35 engine provider (General Electric/Rolls-Royce) would meet the initial provider (Pratt and Whitney) in pricing in 2014, the first year of competition. The study also assumed that competition would result in both an immediate 5% price decrease in engine procurement costs, and steeper rate of reduction in cost for producing subsequent engines (i.e., a steeper slope on the production learning curve).[66]

The CAIG study estimated that an F-35 engine competition would need to achieve a 21.1% reduction in engine procurement costs in constant FY2002 dollars over the lifetime of the program to break even (i.e., to fully offset the costs associated with establishing and maintaining a second source). The study estimated that, when calculated on a net-present-value (NPV) basis,[67] the required amount of procurement-cost reduction would be 25.6%. The study estimated that DOD would be unable to recoup its initial investment in the alternate engine development program through procurement savings alone. The study stated that DOD would need to effectively compete engine operations and support (O&S) contracts to have a chance at attaining a 25.6% savings to reach a break-even point by 2040. The report seemed skeptical that, even with competition on O&S contracts, a 25.6% savings could be achieved.[68]

In addition to the above-mentioned non-financial benefits of engine competition that were cited by all three studies, the CAIG study discussed the issue of growth potential in the F-35 engine. The study estimated that a fourth- or fifth-generation fighter would experience an average of 7.2% weight growth between Critical Design Review (CDR) and Initial Operational Capability (IOC) and an additional 0.3% of weight growth thereafter.[69] Such growth in aircraft weight would eventually require a commensurate growth in engine thrust. The CAIG study stated that Pratt and Whitney's F135 engine was already close to exceeding its designed engine temperature specifications, and would require modifications beyond those that would be needed in the F136 engine to allow for thrust growth.[70]

---

[64] The competition for the F/A-18 engine differed from the Great Engine War in that both GE and Pratt and Whitney competed to build the same engine – the GE-designed F404. Although this did not permit a competition for engine design, it permitted a competition for production price and production quality.

[65] OSD Cost Analysis Improvement Group Report (v6), "F-35/JSF Alternate Engine Acquisition and Independent Cost Analyses," March 15, 2007, Slide 31.

[66] The shift to a steeper learning curve in these analyses is referred to as learning curve rotation. The CAIG study assumed that the learning curve would shift (i.e., rotate) five percentage points. As a notional example, a program might originally have a 90% learning curve, meaning that the second item requires 90% as much labor to build as the first, the fourth requires 90% as much as the second, the eighth requires 90% much as the fourth, the 16th requires 90% as much as the eighth, and so on, with the quantities doubling each time to achieve the next 10% reduction in labor. A five-percentage-point learning curve rotation would mean that this notional learning curve would shift to an 85% slope, so that, for example, the fourth item might now require 85% as much labor to build as the second, and the eighth 85% as much as the fourth, and so on.

[67] An NPV estimate takes into account the real (i.e., above-inflation) investment value of money over time. Government cost-estimating regulations call for using NPV analysis in situations involving an expected stream of expenditures over many years.

[68] OSD CAIG Report, Slide 37.

[69] The CAIG's estimated weight growth prior to IOC is greater than the F-35 Joint Program Office (JPO) estimate of 3%. The JPO also estimates that the F-35's weight will remain unchanged after IOC.

[70] Ibid. Slides 25 and 26. Note: Since the F136 is earlier in its development cycle, analysts comment that its design is (continued...)

IDA Study

The IDA study examined the engine competition for the Air Force F-16 fighter program (the Great Engine War) and the engine competition for the Navy and Marine Corps F/A-18 strike fighter program. The study estimated that an F-35 engine competition would result in a gross savings of 11% to 18%.[71] IDA concluded that past studies of various procurement competitions showed an average (un-weighted) savings of 14.6%.[72]

The IDA study estimated that an alternate engine program for the F-35 would incur direct and indirect investment costs of $8.8 billion in constant FY2006 dollars.[73] The study concluded that it would not be feasible to recoup these investment costs through procurement-cost savings alone. The study determined that for the alternate engine program to break even on an NPV basis, the required amount of procurement-cost savings would be an "unrealistic" 40%, and that the required amount of savings would decline to 18% if engine O&S contracts were also competed.[74] The study stated that DOD "has not typically linked procurement and O&S costs in a single competition" and therefore had limited historical data on which to base an estimate of potential O&S savings.[75]

The IDA study states that contractor responsiveness was "the primary motivation for the Great Engine War."[76] The study stated that F-35s are to constitute 95% of the U.S fighter/strike-fighter force by 2035, and that having an alternate engine could mitigate the risk of the entire F-35 fleet being grounded due to an engine problem. The study stated that enhanced industry responsiveness to engine upgrades and fixes resulting from competitive forces might have a significant effect on overall fleet readiness.

GAO Study

The GAO study stated that procurement-cost savings of 10.3% to 12.3% would be required for the alternate engine program to break even on its investment costs.[77] The study stated that analyses of past engine competitions have shown financial savings of up to 20%.[78] The study concluded that it is reasonable to assume that savings generated from competing the engine would recoup the investment costs. Michael Sullivan, GAO's director of Acquisition and Sourcing Management, stated in testimony that he believed the alternate engine program would reach its

(...continued)

not as set as the F135 and could better incorporate engine growth requirements without major modifications.

[71] Institute for Defense Analyses Report: "Joint Strike Fighter (JSF) Engine Cost Analysis: Summary of Results (Revised)," March 2007, Pg S-3. NOTE: IDA determined a 11% savings from competition over the upgraded F100-220 Pratt and Whitney engine and an 18% savings from competition between the original Pratt and Whitney F100 and the GE F110 (Pg 23).

[72] Ibid. Pg 24. However, IDA noted "significant inconsistencies" with studies of past competitions which need to be taken into consideration when evaluating potential savings.

[73] Ibid., p. 20.

[74] Ibid., p. S-3.

[75] Ibid., p. S-3.

[76] Ibid., p. 44.

[77] *Analysis of Costs for the Joint Strike Fighter Engine Program*, GAO-07-656T, March 22, 2007, p. 1.

[78] Ibid., p. 2.

break-even point by the late 2020s.[79] The study stated that DOD's program management advisory group recommended in 1998 and again in 2002 that the alternate engine program be continued due to its non-financial benefits, in spite of only finding marginal financial benefits.

Recent Developments Concerning F135 Engine

Reported F135 Cost Growth and Quality-Control Issues

A July 27, 2009, press report states:

> United Technologies Corp.'s cost estimate on its engine for the Pentagon's most expensive weapons program had "fairly significant" growth this year, according to the U.S. military's program manager.
>
> The Hartford, Connecticut-based company's 30-year estimate for the engine used on the most widely produced F-35 Joint Strike Fighter model increased 24 percent to $8.3 million apiece from $6.7 million, Marine Corps Brigadier General David Heinz said in an interview. He said that was the biggest annual increase since the program started in 2001.
>
> "So we are challenging them for a 'war on cost' to drive down the cost," of the engine designed by the company's Pratt & Whitney unit, Heinz said. "It's obviously in the government's interest and in Pratt's interest to do so."
>
> Pratt must get the cost estimate back to $6.7 million, he said. "Then I'd know the taxpayer was getting a fair engine for a fair price," he said. "Pratt is working very aggressively to get back to that price."
>
> The new cost estimate figures should factor in the congressional debate over whether the Defense Department proceeds with purchase of a back-up engine under development by Fairfield, Connecticut-based General Electric Co. and London- based Rolls-Royce Plc, Heinz said.
>
> The Pentagon is against buying the back-up engine. Heinz said that, while he supported the Pentagon, it was his job to provide cost and price information to frame an informed congressional debate about the potential merits of competition....
>
> The new cost estimates for the jet's engine highlight the potential value of competition to keep prices in check, Heinz said.
>
> "It is a large jump and I'm very concerned, and it's part of the reason that I think the alternate engine is important for now," he said.
>
> Heinz told reporters last month at the Paris Air Show that having two engines in production seemed a "viable" strategy.
>
> Then-Assistant Air Force Secretary for Acquisition Sue Payton in an internal April 7 memo assessing the F-35's overall status said Pratt's "engine cost growth is an ongoing concern." It was one factor in her grading the F-35 program's fiscal health as "mixed."

[79] Transcript of March 2, 2007, hearing on DOD aircraft programs before the Air and Land Forces subcommittee and the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee.

> Pratt spokeswoman Erin Dick said the company is taking "aggressive steps" to reduce the projected costs. The company is incorporating lessons from cost-reduction initiatives on its F119 engine used to power Lockheed Martin's F-22 fighter that lowered prices by 30 percent, Dick said.
>
> "We believe we have the same opportunities for cost reduction" in the engine for the F-35, which include engineering changes and production improvements among Pratt and subcontractors, she said in an e-mailed statement.
>
> The Pentagon is "pushing" Pratt to improve its scrap and rework rates during manufacturing, which have resulted in one engine scrapped for every one produced and accepted, Heinz said.
>
> The Pentagon wants this rate improved to one engine scrapped for every four accepted, he said. "I'm waiting to see their proposal in September to see how well they are really doing against their plan," Heinz said.[80]

A July 29, 2009, new report states:

> The Pentagon's program manager for the F-35 Lightning II Joint Strike Fighter yesterday criticized the airplane's primary engine manufacturer, Pratt and Whitney, for quality control deficiencies that he says have led to cost growth.
>
> "Pratt can do better, and I am pushing very hard for Pratt to do better in the war on cost," Marine Corps Brig. Gen. David Heinz told reporters following a rollout ceremony here for a Navy variant of the fighter.
>
> United Technologies Corp. [UTX], Pratt's parent company, has increased the cost for the F135 engine from $6.7 million to $8.3 million apiece in its latest estimate.
>
> Heinz said he was particularly dissatisfied with yield rates for certain machined components of the engine.
>
> "There are portions of articles that I am building today that I throw away one for every one I build because the scrap and rework rate has not come up to a lean manufacturing process," he explained. "We are improving those processes every day, but I am not satisfied with the rates that I am getting in yield."
>
> He said a 50 percent yield is unacceptable.
>
> "I believe, even at this point, that [the yield] should be eighty percent—where I'm scrapping one in five [parts] as opposed to one of every two," he said.
>
> Pratt spokeswoman Erin Dick said the company has a plan to improve its production yield.
>
> "Our leaned out production cost and process will improve on the F135 just as it did on the F119 engine powering the F-22 Raptor, whose cost was reduced 30 percent by the time the production was leaned out," she said. "We have that same cost reduction and improvement opportunity with the F135 engine."

[80] Tony Capaccio, "F-35 Engine Shows 'Fairly Significant' Cost Growth," *Bloomberg.com*, July 27, 2009.

> Heinz said he is not concerned about the cost impact for the F-35 program as a whole "from a standpoint that I have enough budget today to accommodate this program." According to Heinz, the budget for the F-35 program has been adjusted in the current fiscal year to reflect the engine cost increase.[81]

An August 7, 2009, press report states:

> A senior Pratt & Whitney official this week defended his company's F135 engine program, calling reports of shoddy workmanship by the company on the F-35 Joint Strike Fighter power plant "grossly inaccurate" and "demoralizing."...
>
> Last week, F-35 Joint Strike Fighter program manager Marine Corps Brig. Gen. David Heinz told reporters that Pratt's F135 engine had a 50 percent scrap rate, meaning the company needs to remanufacture certain components of half the power plants it builds. Pratt emphatically disputes that claim.
>
> "In the case of a couple of parts ... we're at 70 to 80 percent [yield] rate, which at this point in the program is exactly where we should be," William Begert, the vice president of business development for Hartford, CT-based Pratt & Whitney, said in an Aug. 5 interview. This means two or three parts have a 20 percent to 30 percent scrap rate. Begert is a retired Air Force general and a former commander of Pacific Air Forces.
>
> "Overall, we're doing very well on scrap rate," he continued. "We're running 97 percent for the total engine. So to say that we have a 50 percent scrap rate ... is grossly inaccurate. It's just not true."
>
> Begert said the company has had some difficulties with a handful of components—a hallow fan blade, for example—but nothing to the degree expressed by Heinz, who told reporters that, for every two engines Pratt builds, one gets thrown away.
>
> "That is just not true," Begert said. "It's not like you put a whole engine together and decide that it's not going to work and you throw it away. It's individual parts of the engine that you machine and fabricate and build and perhaps some of them are not at the very tight tolerances that you need."
>
> Begert went on to call last week's reports "demoralizing to people who are working very hard and trying to meet customer expectations."
>
> Phone calls and e-mail messages left with the Joint Strike Fighter program office seeking a response to Pratt's assertions were not returned.
>
> Beget did acknowledge the company is not satisfied with engine costs. In an April 7 memo to her successor, then-Air Force acquisition chief Sue Payton wrote that "cost growth is an ongoing concern" with the F135 engine program. (As of press time—Aug. 6—no successor has been named.) From FY-07 to FY-08, issues with the engine led to a $3 million increase in unit recurring flyaway costs for Marine Corps JSF aircraft, according to the memo.
>
> "We're not where we want to be on the projected curve going forward," Begert said, referring to a chart that projects the program's cost over the next 30 years.

[81] Marina Malenic, "Heinz Raps Pratt On F-35 Engine Manufacturing Practices," *Defense Daily*, July 29, 2009: 3. Material in brackets as in original.

> "But we are taking lots of actions to get on that curve," he continued. "We've had an independent review with the government on the actions that we're taking, and they feel very satisfied that if we keep doing the things that we're doing ... we will get to the cost curve."
>
> Begert compared issues with the F135 effort similar to ones experienced early on when the company built the F119 engine for the F-22A Raptor.
>
> "There is a curve that takes it to where the cost is per engine today and over time as you build more engines—and the more engines you build, the better you are at this—you drive down cost, because you get better supplier quotes, you get better producibility and over time these projections show you coming down to where you should be," he said.[82]

DOD Team to Review F135 Cost Issues and Report by November 20

A September 8, 2009, press report states:

> A high-level, independent Joint Assessment Team (JAT) has been formed by the Pentagon's chief procurement executive to investigate concerns about a surge in the projected cost of the Pratt & Whitney F135 engine for the F-35 Joint Strike Fighter (JSF)—even as the Pentagon and White House move to shut down the General Electric/Rolls-Royce F136 alternate engine and eliminate the engine competition that has been an integral part of the program since 1996.
>
> Undersecretary of Defense for acquisition, technology and logistics Ashton Carter is understood to have set up the JAT following a late July meeting with the JSF joint program office (JPO), where JSF leaders warned that F135 costs appeared to be headed for higher-than-budgeted levels. JSF director Brig. Gen. David Heinz has expressed concern about F135 costs, but has reportedly been cautioned against public comments by Defense Secretary Robert Gates.
>
> The team is working on a tight schedule, visiting Pratt & Whitney later this month and reporting by early October. What's also unusual is that its reported tasks are in line with tasks that a system project office would normally handle internally.
>
> Carter has asked former acquisition official and DHS deputy secretary Paul Schneider to chair the JAT, which will include Pentagon, Air Force and Navy representatives along with some outside consultants. Its goal, industry sources say, is to investigate and understand Pratt & Whitney's cost structure and help the JSF office in its assessment of the company's latest Low Rate Initial Production (LRIP) IV bid. The JAT also will look at scrap rates and other production issues.

[82] Marcus Weisgerber, "Pratt & Whitney: Allegations About F135 Engine Scrap Rates 'Not True' (Updated), *Inside the Air Force*, August 7, 2009. The version shown here is an updated online version. There is an editorial note at the start of this version that states: "Clarification: Subsequent to publication, a Pratt & Whitney spokesman said William Begert, vice president of business development, misspoke when he said some parts of the F135 engine were at "70 to 80 percent scrap rate." In the case of two or three components, there is a 70 percent to 80 percent yield rate, meaning the scrap rate is 20 percent to 30 percent. Also, the original story reported that Begert called F-35 Program Manager Brig. Gen. David Heinz's comments' about the Pratt & Whitney F135 engine "grossly inaccurate" and "demoralizing." Begert was responding to the media reports not the general's comments. The story has been updated to reflect the changes."

> Pratt & Whitney, meanwhile, says that the company "continues to work aggressively with the JPO to reduce the cost of the F135 engine and we have made progress. Our upcoming LRIP IV Proposal reflects confidence in our cost reduction strategy."
>
> Engine costs are a major issue for the JSF because the program's unit cost goals are extremely challenging. On Aug. 31, Gates visited Lockheed Martin's Fort Worth plant and stated that the fighter would cost only half as much as the F-22 in full production.[83]

A September 9, 2009 press report states:

> U.S. defense acquisition chief Ashton Carter has ordered a high-level panel to review all aspects of development and production of the F-35's primary engine by Nov. 20, according to a Pentagon memorandum.
>
> The joint acquisition team (JAT) Carter has established to review the F135 engine program should look at "all aspects of development and production of the F135 engine, with primary focus on understanding the production cost, cost drivers, cost projections and long-term affordability of the F135," Carter wrote in a recent memo.
>
> Carter has directed the review team to "develop a plan to address F135 cost and affordability," states the undated memo, obtained by Defense News on Sept. 9....
>
> The acquisition, technology and logistics chief stated in the memo that he became concerned about F135 costs earlier this summer after being briefed by the F-35 program office on the fighter effort. That briefing, he wrote, covered "projected cost growth in Pratt & Whitney's F135 engines." The new primary engine cost expectations "are outside the bounds of Selected Acquisition Report projections, and I am concerned about continued cost growth in the F135," Carter wrote.
>
> Industry sources say the primary engine effort is nearly $2 billion over budget.
>
> The special acquisition team, Carter has directed, should work with the F-35 joint program office to "understand the F135 cost structure, cost drivers, and current baseline cost/price track," according to the memo.
>
> The team also should "identify focus areas that adversely impact engine affordability projections," according to the document. It also should describe possible cost-reduction options.
>
> Further, Carter has directed the JAT to work with the F-35 program office to develop a "reasonable cost" for the program's low-rate initial production IV phase. Its work with the F-35 program office also should include developing a new cost projection for the 2009 SAR round, which informs lawmakers of Pentagon weapon programs that are dramatically over budget.
>
> "We are looking forward to the opportunity to host the Joint Assessment Team, and show them the results of our cost reduction efforts over these last months," Pratt & Whitney spokesperson Erin Dick said. "We are confident we can provide the team a level of detail that will reinforce our cost commitment to the Joint Program Office. Pratt & Whitney has

[83] Bill Sweetman, "Government Sends F135 Tiger Team Into Pratt & Whitney," *Aerospace Daily & Defense Report*, September 8, 2009: 3.

developed a plan to reduce the production cost of the F135 propulsion system. We have taken very aggressive steps to make this happen, and we have made progress.

"We will demonstrate to the JAT that the learned out cost targets for the F135 engine and Rolls Royce STOVL Lift System are achievable," Dick said. "We will provide them all the information they need to understand the progress we are making with respect to F135 propulsion cost and our continued way ahead. With the Pratt & Whitney F119, currently powering the F-22, we were able to achieve a 30 percent cost reduction from development to production, and we are applying the same lessons learned on the F135 and are on the path to achieve similar cost savings."...

The team must examine the F-35 joint program office, F-135 prime contractor Pratt & Whitney, and the primary power plant's major suppliers, according to the memo. The JAT must visit the F-35 program office and Pratt by Sept. 14. Carter has instructed the team to deliver preliminary findings by Oct. 9 to the Pentagon's director or portfolio systems acquisition, and the Navy and Air Force acquisition executives.

The AT&L chief wants the special team to assess F135 manufacturing issues.

He directs it to "assess wrap-rates, scrap rates, quality and plans to transition from development to production rates," as well as "the learning curve and compare F119 vs. F135 processes."

The F119, also developed by Pratt & Whitney, powers the U.S. Air Force's F-22 fleet.

Carter also wants data on Pratt's management of F135 subcontractors, instructing the team to "assess subcontractor cost management and subcontractor technical oversight."

The memo also orders a look at F135 business strategies. Carter wants the JAT to examine the following: "overhead rate challenges, breakout parts strategies (mainly an activity looking at Rolls Royce), contract structure and incentives, fees (including profit and material handling) and development of alternative component suppliers."[84]

Pratt and Whitney Offer to Reduce F135 Engine Cost

A September 10, 2009, press report states:

Responding to competitive pressure from a rival engine manufacturing team, the producer of the main engine for the Defense Department's newest fighter jet will also offer the Pentagon a better deal.

Connecticut-based Pratt & Whitney [UTX], developer of the F135 engine for the new F-35 Joint Strike Fighter, is preparing a counter-offer to a proposal from General Electric [GE] and partner Rolls-Royce that would provide the government with a firm, fixed price for its F136 engine. The GE-Rolls team made its offer, which would replace a traditional cost-plus arrangement in which the government takes on more financial risk, to Pentagon officials last week ... .

A Pratt spokeswoman said yesterday that the company will offer its own fixed-price deal in response to its rival's new proposal.

[84] John T. Bennett, "Team Must Complete F135 Engine Review by Nov. 20," *DefenseNews.com,* September 9, 2009.

> "GE recently offered an unsolicited firm fixed price on their alternate engine," Erin Dick told Defense Daily. "We have worked very aggressively to reduce our costs for the F135 engine and have made progress. Our upcoming ... proposal reflects confidence in our cost reduction strategy and significantly lowers the risk to the government. The proposal will provide protection to the government from cost increases and safeguard against engine cost growth."
>
> Dick added that the offer will be for a fixed-price contract beginning with the fourth low-rate initial production lot. She declined to specify the new cost structure....
>
> Heinz's office declined to comment on Pratt's pending offer.[85]

A September 16, 2009, press report states:

> Pratt & Whitney [UTX] yesterday submitted a proposal to the Pentagon that would save the department at least 10 percent on the cost of future F135 engines the company is building for the military's newest fighter jet, company officials said.
>
> "If there are cost overruns or unexpected price changes, we will absorb that up to a certain point," Bill Begert, the company's head of business development, told reporters at the Air Force Association's annual conference at National Harbor.
>
> Pratt's proposal would take effect beginning with the fourth low-rate initial production lot of engines for the F-35 Joint Strike Fighter.
>
> Begert said the new proposal, like Pratt's existing deal on the work, is a cost-plus contract. He said the company had offered the government a fixed-price deal over the summer but that their offer was rejected, likely because "they get visibility into the cost structure…under cost-plus that they may not under fixed price."
>
> "We're trying to get as close to a fixed-priced contract as the government is comfortable with," he added. "I think they are comfortable with the strategy they have…What we wanted to do was honor that, stay with that, but assume some more risk."
>
> The fourth batch of LRIP includes 20 of the conventional takeoff and landing (CTOL) variant and 17 short take-off/vertical landing (STOVL) aircraft that will be flown by the Marine Corps.
>
> The STOVL variant includes a lift fan built by Rolls-Royce. The aircraft has encountered developmental challenges, with its flight test schedule experiencing multiple delays this year.
>
> Rolls has also teamed with General Electric [GE] to develop the alternate F136 engine that has been funded by Congress for several years but singled out by President Obama as a prime example of wasteful government spending. The Rolls-GE team earlier this month offered the Pentagon a fixed-price contract for its engine.
>
> Jean Lydon-Rodgers, president of the GE Rolls-Royce Fighter Engine Team, said that offer has already changed Pratt's behavior by prompting the company to offer a better price on its engine.

[85] Marina Malenic, "Pratt Prepares To Counter GE Fixed-Price Gambit On F-35 Engine," *Defense Daily*, September 10, 2009: 6-7.

> "We're already seeing the benefits of competition," Lydon-Rodgers told Defense Daily in an interview yesterday. "I think it's clear that behavior changes as a result of that competition."
>
> She added that GE executives continue to meet with Pentagon officials to discuss their offer.
>
> Meanwhile, Pratt officials said yesterday that an anomaly discovered during stress testing of the F135 on Friday is still under investigation. Begert said the worst-case scenario would be discovery of a durability problem but that foreign object damage or a defective component could also be to blame for the problems.[86]

F135 Engine Damaged in Test on September 11, 2009

A September 13, 2009, press report states:

> United Technologies Corp (UTX.N) on Sunday said the forward section of the F135 engine it builds for the Lockheed Martin Corp (LMT.N) F-35 fighter jet was damaged during a qualification test on Friday.
>
> Pratt & Whitney, the United Technologies unit doing the work, said an investigation was ongoing and it was working closely with Lockheed and the Pentagon's F-35 program office to find the root cause of the problem and resolve the issue.
>
> Pratt spokeswoman Erin Dick said the issue was not expected to affect the F-35 flight test schedule since those aircraft are powered by the first generation of the F135 engine, which has been fully tested, while the damage occurred to a second generation of the engine that was still being tested.
>
> The company said the engine would be taken off the test line, but the F-35 program office estimated it would take five days to determine root cause and any corrective action....
>
> Pratt said the incident occurred during a qualification test on an F135 engine built for the conventional takeoff and landing version of the fighter to be flown by the Air Force.
>
> It said there was no damage to the turbine section of the engine, which was redesigned after problems two years ago.
>
> SPARKS OUT THE TAIL PIPE
>
> A company program expert said the incident occurred on Friday evening, during the fifth of 11 hours of planned testing of the engine under supersonic conditions, when the engine began producing "sparks out the tail pipe."
>
> He said the damage was mostly to the first and second fan blades, and the engine continued to run and produce thrust.
>
> Pratt had completed about 95 percent of the qualification test when the incident occurred, and the engine had run through 2,455 cycles, an amount equal to eight years of operation, he said, adding, "This engine was pushed very, very hard."

[86] Marina Malenic, "Pratt Offers To Trim F135 Costs," *Defense Daily*, September 16, 2009: 1.

> It was not immediately clear if the incident occurred because the engine ingested some foreign object, such as a nut or bolt from testing equipment, or if the damage resulted from some manufacturing defect or a structural issue triggered by the supersonic conditions, said the program expert.
>
> To fix the damaged engine, the company would have to make some "very specific targeted hardware replacements," but not a significant overhaul of the entire engine, the expert said.
>
> Dick said the company wanted to disclose incident as quickly as possible, especially given the ongoing debate over funding for the alternate GE-Rolls engine. "We recognize that this is a heated discussion. We wanted to make sure that we got the right information out as quickly as possible," she said.
>
> Dick said Pratt had had relatively few incidents during the development of the new F135 engine, partly because it was based on the Pratt F119 engine that powers the F-22 fighter jet....
>
> Dick said this incident showed that having a single engine did not make the F-35 more susceptible to a fleetwide grounding. The program office had not ordered any hold on flight testing because the engines powering the test aircraft were from an earlier generation, while this incident occurred with a "second-generation" engine, or later model.
>
> "If you have something that impacts one generation, you still have the other previous generations that have been proven," she said, calling the chance of a fleetwide grounding that would affect all generations "almost nill."

A September 14, 2009, press report states:

> A problem with the F135 engine built by United Technologies Corp (UTX.N) for the F-35 fighter should not delay the program's flight test schedule, a senior program official said on Monday.
>
> Air Force Major General C.D. Moore, the program's deputy executive officer, told reporters on Monday that he remained confident that the $300 billion Lockheed Martin Corp (LMT.N) program could meet its cost and schedule targets.
>
> Pratt & Whitney, a United Technologies unit, on Sunday said part of an F135 engine was damaged during testing on Friday, and work was underway to determine the cause.
>
> Moore said he was optimistic about resolving the issue because an earlier version of the engine had already passed the certification testing. "I'm not losing sleep over it," he told Reuters after the news conference.
>
> Moore declined comment when asked if the event could spur additional support for an alternate engine being developed by General Electric Co (GE.N) and Britain's Rolls-Royce Group PLC (RR.L), which the Obama administration has targeted for cuts.
>
> The Pentagon has long advocated halting the alternate engine program—which Congress initiated and has funded for years despite White House opposition—and proceeding with a single engine. Many other weapons programs had been successful with one engine, he said.
>
> But Moore conceded the timing of the engine incident was unfortunate. "This could be a nonissue, but it's the political implications that go with it," he said.

> Defense Secretary Robert Gates last month threw his support behind the F-35 program and said the most high-risk issues facing the fighter were behind it, but congressional aides seized on the latest Pratt engine problem as evidence that more issues could arise.
>
> Pratt already had to redesign part of the engine after a problem arose during testing in 2007, an effort that added hundreds of millions to program costs and delayed flight tests of the short takeoff, vertical landing (STOVL) variant....
>
> A high-level Pentagon team visited the Pratt factory last week to study an expected surge in projected costs for the engine, but Pratt officials said the visit went well.
>
> William Begert, vice president of business development for the company, said Pratt was working to lower longer-term costs through engineering and manufacturing improvements.
>
> He said a big part of the $1.9 billion in the program's cost growth had been due to factors beyond Pratt's control, including foreign exchange fluctuations on the lift fan, which is produced by Rolls-Royce for both engine teams.
>
> Several hundred million dollars more stemmed from engineering changes needed to add power to the engine after the airplane grew heavier, he said.
>
> Begert said the engine damaged during test was arriving at another Pratt facility in Connecticut this week, and officials should have a good idea pretty quickly what went wrong.
>
> He said he would be surprised if the problem turned out to be a design issue since an earlier version of the engine had passed testing and was now being used in flight tests. "This is unlike the third blade problem" of 2007, he said.
>
> More likely, he said, it was a one-off manufacturing defect.[87]

A September 15, 2009, press report states:

> A Pratt & Whitney F135 engine for the F-35 Joint Strike Fighter has been damaged during qualification ground testing.
>
> The news comes as the Pentagon scrutinizes the F135's costs and Congress prepares to decide the future of the General Electric/Rolls-Royce F136 alternate engine....
>
> The conventional takeoff and landing F135 was 2,455 cycles into a 2,600-cycle durability test leading to initial service release when "sparks were noticed coming out of the jet pipe," says a Pratt & Whitney program expert. The engine was still running and capable of producing thrust when it was shut down.
>
> Inspection revealed tip damage to a "handful" of blades on the first and second fan stages, which are integrally bladed rotors (IBR). Downstream damage was confined to the compressor. There was no visible damage to the combustor and turbine.

[87] Andrea Shalal-Esa, "Engine Issue Should Not Delay U.S. F-35 Flight Tests (Update 2)," *Reuters.com,* September 14, 2009.

> Pratt is working to identify the root cause, which could be foreign object damage from something outside the engine, or "domestic object damage" from something failing inside the engine, perhaps due to a manufacturing defect or durability issue.
>
> The F135 was five hours into an 11-hour supersonic high-cycle fatigue test and was "being pushed very hard" through a sequence of throttle transients designed to excite blade vibration. For this test, the inlet-plenum hardware on the test stand had recently been changed to run at supersonic conditions.
>
> Pratt says inspection of the inlet hardware is under way, but no missing pieces such as bolts or seals have yet been found. The engine is being torn down. "There is something at the bottom of the engine [between the fan and compressor] that we want to retrieve," the program expert says.
>
> As for the effect to the F-35 program, the expert says the Joint Program Office is estimating it will take Pratt five days to identify the root cause and the corrective action.
>
> If it is a durability issue, the expert says there is plenty of time to design and retrofit a fix as the test engine had accumulated the equivalent of eight years in service when the damage occurred.
>
> Pratt also says there should be no effect on F-35 flight-testing, as the engine that failed has the "second-generation" IBR fan, which is lighter. The flight-test engines have the first-generation fan, which has already undergone durability testing, the company says. There is no halt to flight-testing or engine ground testing, Pratt says.
>
> Two other second-generation engines are in ground test and are being examined. The damaged engine should be repairable to complete qualification testing, the expert says. The fan will have to be replaced, but damage to the compressor blades is blendable and the rest of the turbomachinery looks undamaged.[88]

Another September 15, 2009, press report states:

> A mishap during a test of a Pratt & Whitney engine could increase pressure on the administration to keep developing an alternate engine for the F-35 Joint Strike Fighter, lawmakers and military analysts said Monday.
>
> President Obama has pushed to cancel the rival engine, made by General Electric and Rolls-Royce, saying it was an example of the wasteful duplication he wants to eliminate.
>
> But several Congressional leaders contend that competition could produce better engines and cost savings for the single-engine F-35, the Pentagon's most expensive weapons program. And the testing mishap late Friday, which damaged an engine, seems likely to intensify that dispute as Congress completes work on a military spending bill later this month.
>
> Pratt & Whitney, a unit of United Technologies, said on Monday that it was still trying to determine what had caused the engine to spew sparks in the middle of a lengthy test, and it was not clear yet how serious the problem was.

[88] Graham Warwick, "F135 Engine Damaged In Ground Tests," *Aerospace Daily & Defense Report*, September 15, 2009. A very similar version of this article was published on September 14, 2009, as Graham Warwick, "F135 Engine Damaged In Ground Tests," *AviationWeek.com*, September 14, 2009.

> But Pentagon officials also recently criticized the company for more than $1 billion in cost overruns, and that has helped feed the debate over whether it should rely on one supplier for such a critical program.
>
> The Pentagon and at least eight countries are expected to eventually spend more than $1 trillion to buy and maintain more than 5,000 of the planes, developed by Lockheed Martin and intended to strike ground targets as well as fight other planes. The engine contracts alone could be worth more than $100 billion, and Congress has long insisted that the Pentagon hold annual competitions for the contracts by 2015....
>
> Jacques S. Gansler, who was the top Pentagon acquisition official under President Bill Clinton, said the F-16 [engine] competition, often referred to the great engine war, offered "an incredible analogy" that could be repeated with the F-35.
>
> Besides long-term savings, he said, the competition could encourage innovation and produce more reliable engines.
>
> But Geoff Morrell, a Pentagon spokesman, said on Monday that it would cost an additional $2 billion to $3 billion to finish developing the G.E. and Rolls-Royce engine and buy enough early versions to put it on the same footing as the Pratt & Whitney version.
>
> Ashton B. Carter, who is the Pentagon's top acquisition official, said last week that he was also "very concerned" about some of Pratt & Whitney's problems and was monitoring them closely.
>
> But, he said, "a second engine could encounter the same kind of problems as the first engine." He also said that given the start-up and other costs, recent Pentagon studies do not show that having a second engine "will, in fact, predictably deliver savings compared to one engine."
>
> Even though the Obama administration has said it intends to increase competition in Pentagon contracting, Mr. Carter added: "Competition doesn't mean buying two of everything."...
>
> Still, all the controversy seems likely to bring down the costs no matter what Congress decides. To try to save their project, G.E. and Rolls-Royce recently offered to develop the rest of their engine under a fixed-price contract instead of the current one in which the Pentagon covers any cost increases.
>
> And Pratt & Whitney has said it would make a new contract offer to the Pentagon under which it would also absorb cost increases. William J. Begert, the company's vice president for business development, said it also had been investing its own money to improve its production process and lower the cost of the engine.[89]

A September 18, 2009, press report states:

> According to a DOD information paper on the incident—dated Sept. 14—an inspection revealed "significant damage to the fan and compressor" of the engine. The engine is "irreparable," according to a congressional source.[90]

[89] Christopher Drew, "Mishap Raises Questions About Pratt & Whitney F-35 Engine," *New York Times*, September 15, 2009.

[90] Jason Simpson, "GE: No Way Forward In F136 Development Without FY-10 Funding," *Inside the Air Force*, (continued...)

A September 19, 2009, press report states:

> Pratt & Whitney said on Friday [September 18, 2009] that a worn metal fitting appeared to have caused a recent mishap with an F-35 test engine, and it said the problem could be fixed with minor changes.
>
> The company, a unit of United Technologies, said the modifications would not delay the development of the F-35, a stealth fighter that represents the Pentagon's largest acquisition program....
>
> Officials at Pratt & Whitney, which is based in East Hartford, Conn., said on Friday that they believed that the defective part—a thin metal tube, or bushing, that holds two parts together—degraded over time.
>
> That created an aerodynamic disturbance that damaged the tip of a fan blade, they said. They added that two changes—inspecting the bushings more often and clipping off the edge of the blade—could keep the problem from recurring.[91]

A similar September 21, 2009, press report states:

> Pratt & Whitney says the "probable cause" of fan-blade damage during ground testing of the F135 engine for the F-35 Joint Strike Fighter was a worn bushing—a part in the fan inlet case—causing an aerodynamic disturbance that led to a piece of the tip of a first-stage fan blade breaking off.
>
> A "minor modification" will be incorporated immediately in all initial service release (ISR) production engines "with little or no impact on cost and schedule," the company said during a teleconference Sept. 18. The blade tips will be clipped off at their trailing edges to remove the area susceptible to damage, a solution Pratt describes as "standard industry practice"....
>
> Blade damage occurred 2,455 cycles into a 2,600-cycle durability test—at the equivalent of eight years of in-service operation—and 5 hours into an 11-hour supersonic high-cycle fatigue test designed to excite vibration of the fan blades via throttle transients. Tear-down of the engine revealed all of the bushings were degraded.
>
> The ISR engine for production F-35s has lighter "second-generation" integrally bladed rotors in the two-stage fan. F135s powering flight-test aircraft have a first-generation fan that has already passed durability testing, Pratt says. The F-35 Joint Program Office and Lockheed Martin have previously said no effect to flight testing was expected.[92]

(...continued)

September 18, 2009.

[91] Christopher Drew, "Maker Of F-35 Engine Traces Problem To A Tube," *New York Times*, September 19, 2009: B2.

[92] Graham Warwick, "Pratt Identifies Probable Cause Of F135 Failure, Aerospace *Daily & Defense Report*, September 21, 2009: 3. See also Jason Simpson, "Pratt & Whitney Discovers Root Cause of F135 Test Engine Failure," *Inside the Air Force*, September 25, 2009, which presents similar information.

Recent Developments Concerning F136 Engine

General Electric/Rolls-Royce Offer for F136 Fixed-Price Contract

A September 1, 2009, press report states:

> General Electric and Rolls Royce Sept. 1 pitched Pentagon officials on a plan under which the companies would sell the U.S. military F136 engines for the Joint Strike Fighter (JSF) through a fixed-price contract, Defense News has learned.
>
> Russ Sparks, GE Aviation's vice president and general manager of military systems, and other GE and Rolls brass huddled this afternoon with Shay Assad, director of the defense procurement, acquisition policy and strategic sourcing, and Marine Corps Maj. Gen. David Heinz, JSF program executive officer. Assad is a top adviser to Pentagon acquisition chief Ashton Carter.
>
> The companies presented Assad and Heinz with what Sparks called "a new business plan" for the F-35 alternative engine effort, under which GE and Rolls would sell the military more than 100 F136 units using a fixed-price, not cost-plus, contract for delivery between 2013 and 2015....
>
> Sparks said the proposal, which the companies have been discussing with the F-35 program office for several months, would pare the price tag and shift more risk on initial production engines to the GE-Rolls team.
>
> He said cost estimates put the JSF's main engine, being developed by Pratt & Whitney, nearly $2 billion over budget.
>
> GE-Rolls F136 officials say the fixed-price plan was hatched after the team studied the 2009 Weapon Systems Acquisition Reform Act, which calls for more competition through the entire life of major defense weapon programs.
>
> "We are volunteering to the pilot program for the acquisition reform act," Sparks said.
>
> Part of the GE and Rolls officials' pitch for using a fixed-price contract is to allow the Pentagon "to show a greater return earlier" by inserting a new level of competition - the lower price of the first 100 or so F136s - into the JEF engine effort.
>
> If the GE-Rolls engine initiative is kept alive long enough by the Pentagon and Congress, it is slated to enter a head-to-head competition with the Pratt & Whitney power plant in 2014. The winner would be delivered to DoD in 2016.
>
> Sparks said GE-Rolls F136 officials have concluded that the Office of the Secretary of Defense's "issue is not with building a second engine - it's with the current business case in a time of other pressures on the defense budget."We're going to give them a different view with a new business case based on a fixed-price contract," Sparks said. "We are trying to align ourselves with the desires of both the administration and the Congress."
>
> President Barack Obama has singled out the alternative engine program as wasteful and unnecessary several times during public comments about finally bringing about Pentagon purchasing reforms.
>
> But Sparks said the president and other administration officials also have endorsed using fixed-price contracts more often in place of cost-plus award fee deals, which routinely allow

> contracts to rake in millions or billions above the initial contract value when costly design changes are made.
>
> GE and Rolls officials hope that a switch to a fixed-price arrangement would keep alive the F136 program while allowing all sides to claim victory.
>
> "We know we can't win this fighting them," Sparks said....
>
> Sparks said he could not comment on the potential value of the proposed fixed-price deal.
>
> He also declined to disclose the GE-Rolls team's estimate on how much such an approach might save the government.
>
> But he did point to the fixed-price contracts that were used in the so-called "Great Engine War," a 20-year battle to provide engines for the F-16 fighter.
>
> "The government's view is the savings then was 20 percent," he said. "And some estimates are for the size of the JSF program, over the life of the program - both the U.S. and international fleets - the engine program could cost $100 billion. Take 20 percent of that - it's a big number."
>
> OSD and the JSF program office have "cost targets" for each phase of the F-35 engine program, he said. The fixed-price proposal is based on those targets, and the GE official said the F136 team is "very close" to the Pentagon's cost figures.
>
> "We are proud to be as close as we are," Sparks said. "If this doesn't convince [Pentagon officials], I'm afraid nothing will."[93]

A similar September 3, 2009, press report states:

> General Electric (GE) and Rolls-Royce have opened talks with U.S. defense officials on a fixed-price contract offer for the F-35 Joint Strike Fighter (JSF) alternative F136 engine that they hope will be a bellwether for the government's acquisition reform goals by forcing a similar reaction from incumbent F135 engine supplier Pratt & Whitney (P&W).
>
> The contract plan, first revealed in Aviation Week, covers several options including a fixed price offer for around 100 engines in the low-rate initial production Lots 5 and 6. "What we finally offer will be led by the Pentagon," says a GE spokesman, who adds the gambit is designed to "force Pratt & Whitney's hand. We're hoping they'll react with a fixed-price deal of their own."
>
> GE and Rolls-Royce say that should P&W respond in like manner, it will spark competition on costs ahead of the first Lot 7 buy originally scheduled to be openly contested between the F135 and F136 engines. "We think this could accelerate the whole program and generate savings well before 2016," GE adds. Under initial acquisition plans, GE and Rolls-Royce claimed potential savings of up to 20 percent could be feasible, but only two years or so after Lot 7 was due to be contested in 2014.
>
> The meetings, which took place on Sept. 1, included JSF program executive officer Marine Corps Maj. Gen. David Heinz, Shay Assad, director of the defense procurement, acquisition

[93] John T. Bennett, "GE Pitches Fixed-Price Deal For Alternate JSF Engine," *DefenseNews.com*, September 1, 2009.

policy and strategic sourcing, and Russ Sparks, GE Aviation's vice president and general manager of military systems....

GE Rolls-Royce meanwhile acknowledges that the second F136 development engine, 625-005, is being inspected in Evendale, Ohio, after ingesting a test sensor. The engine, which had run for around eight hours when the incident occurred, had been "running well, and had reached maximum speed with zero problems," the GE spokesman says. The engine was shut down "when a reading on one of the sensors went haywire," he says.

The engine is expected to return to test "within weeks rather than months," and the plan is for three development engines to be running concurrently by the end of November. Engine 004, which also shut down prematurely earlier this year after debris was found in the oil system, is expected to start phase 2 engine performance tests within weeks. The third engine to join the tests, 006, will be used for accelerated mission testing to prepare for initial flight release on the Lockheed Martin F-35. Production engine 041 is designated to power F-35 conventional take-off and landing test aircraft AF-1, and is due to be shipped to Lockheed Martin in early 2010. Engines 007 and 008 are aimed at short take-off and vertical landing (STOVL) tests, with 008 undertaking the flight qualification work. Should the engine survive the budget crisis, first flight of the F136-powered F-35C STOVL variant is set for 2011.[94]

F136 Engine Damaged in Test on October 2, 2009

An October 8, 2009, press report states:

A General Electric-Rolls-Royce engine for the F-35 Joint Strike Fighter program experienced "impact damage" during a ground test last week, according to a Pentagon document.

GE-Rolls-Royce F136 engine officials were conducting a routine borescope inspection of the second system design and development test engine in the program following an Oct. 4 test when they noticed the problem, according to a JSF program office statement on the incident provided by a congressional source.

Program office spokeswoman Cheryl Limrick confirmed the validity of the report in an Oct. 8 e-mail.

The Fighter Engine Team officials noticed "several" high pressure turbine rotor blades with "impact damage" and, upon further inspections, "impact damage on the leading edges of several blades" was revealed on stages 1, 2 and 3 of the low-pressure turbine rotor.

In addition, borescope inspection revealed "distress and missing material" within two combustor panels, the statement reads.

The engine in question was tested "over several days last week" and was 75 percent through its test phase prior to the incident, Fighter Engine Team spokesman George McLaren said in an Oct. 8 e-mail. The engine achieved three hours of non-stop maximum power during those tests.

[94] Guy Norris, "Alternate JSF Engine Team Puts Pressure On Pratt & Whitney," *Aerospace Daily & Defense Report*, September 3, 2009: 1-2. See also Marina Malenic and Emelie Rutherford, "GE, Rolls-Royce Look To Align With Acquisition Reformers In Fixed Price Engine Offer," *Defense Daily*, September 3, 2009: 6.

> "The engine was operating normally and there was no sign of any problem evident to the test staff," he said. "Following a scheduled shutdown at the end of last week, a routine borescope inspection revealed minor impact damage on some turbine blades. There was no sign of damage in the compressor or fan."
>
> Congress was notified of the incident late on Oct. 7, according to the source. Earlier this week, the Senate and House Armed Services committees agreed in conference to fund the second engine program amidst White House veto threats. Defense Secretary Robert Gates has repeated the veto threat numerous times over the past several months.
>
> The Pentagon statement added that the JSF program office intends to document and assess the F136 testing mishap. Program office officials could know the length of time it will take to complete a root cause corrective action investigation by Oct. 9, and the engine in question has been removed from testing until the assessment is completed.
>
> GE-Rolls-Royce officials have identified a potential cause "and are working to confirm that now," McLaren said. "We should know more in a few days."
>
> JSF officials expect that the engine will return to testing "later this year," Limrick said in her e-mail.[95]

An October 9, 2009, press report states:

> The decision to tear down an F136 test engine for closer inspection following discovery of turbine damage has halted development testing on the alternate powerplant for the Lockheed Martin F-35 Joint Strike Fighter, at least temporarily.
>
> The second development F136, engine number 5, is being torn down and checked after "dings and nicks" were found on turbine blades during inspection following an extended maximum-thrust test run, says the General Electric/Rolls-Royce (GE/RR) Fighter Engine Team.
>
> Engine number 4, the first development F136, has completed its most recent test runs and is being readied for the next phase.
>
> The next development engine, number 6, is in final assembly and is expected to run "within a couple of months," GE/RR says....
>
> The incident occurred late on Friday, Oct. 2, but was only acknowledged publicly Oct. 7. The engine is about 75 percent through a test phase that "included extended operation at maximum power, normal operation and controlled shutdown," GE/RR says.
>
> There was no indication of an anomaly during the test, which included three hours at maximum power, GE/RR says, adding that the damage was discovered during a routine borescope inspection after a normal shutdown at the end of the run in the Cincinnati, Ohio, test cell.
>
> "At the time of the shutdown, the engine was running normally with no signs of issues," GE/RR says. "It was decided that before resuming the testing a thorough engine inspection

[95] Jason Simpson, "F136 Engine Sustains Impact Damage in Test, Possible Cause IDed (Updated)," *InsideDefense.com (DefenseAlert – Daily News)*, October 8, 2009.

> be conducted. There was no sign of damage in the compressor or fan." The turbine damage is repairable, the team says.
>
> There have been two previous test incidents with development F136s, both affecting engine number 4—one involving a misadjusted bearing, which did not result in damage, and the other the ingestion of test instrumentation that came loose.[96]

Another October 9, 2009, press report states:

> Testing of the F136 alternate engine for the F-35 Joint Strike Fighter (JSF) was halted by its manufacturers this week after a routine inspection revealed "dings and nicks" on the turbine blades, according to industry and government officials.
>
> "This weekend, GE/RR were about 75 percent through a test engine phase in the test cell in Cincinnati that included extended operation at maximum power, normal operation and controlled shutdown," General Electric spokesman Rick Kennedy said. General Electric [GE] is developing the engine along with its partner Rolls-Royce.
>
> The companies performed a borescope inspection and "found dings and nicks" on the turbine blades, according to Kennedy.
>
> "At the time of the shutdown, the engine was running normally with no signs of issues," he added.
>
> The companies decided a more thorough inspection was necessary. Kennedy said there was no sign of damage in the compressor or fan and that this incident would not require any redesign of the engine.
>
> "The GE/RR issue wasn't an engine failure, but we've got to make sure we know exactly what happened," he said.
>
> The JSF program office, meanwhile, said that further inspections "revealed Stages 1, 2, & 3 of the Low Pressure Turbine (LPT) rotor also sustained impact damage on the leading edges of several blades.
>
> During borescope of the Combustor/Diffuser/Nozzle (CDN) assembly, 2 combustor diffuser inner panels were found with distress and missing material."
>
> A detailed inspection of the CDN assembly will be performed, according to a statement released by the program office. Initial results are expected today, the statement said.
>
> Kennedy said that the program office's statement "is likely correct—it appears a static part in the combustor went free, given the fan and compressor were fine."[97]

[96] Graham Warwick, "Damage Discovery Halts F136 Engine Testing," *Aerospace Daily & Defense Report*, October 9, 2009: 3.

[97] Marina Malenic, "F136 Engine Testing Suspended After Discovery of 'Dings and Nicks,'" *Defense Daily*, October 9, 2009: 1.

"Great Engine War" of 1984-1994[98]

Congress's interest in establishing and funding an F-35 alternate engine program may have been informed by "the Great Engine War"—an annual competition from 1984 to 1994 between Pratt and Whitney and General Electric to produce and maintain engines for Air Force F-16 fighters.[99] Pratt and Whitney's engine for the F-16 was the F100, which was originally developed for the Air Force F-15 fighter. General Electric's alternate engine for the F-16 was the F110.

Historians trace the Air Force's interest in pursuing an alternate engine for the F-16 to Air Force frustrations in the 1970s with Pratt and Whitney's management of the effort to develop the F100, and to Air Force concerns about using a single type of sole-sourced engine to power their entire fighter fleet of F-15s and F-16s.[100] After a number of contentious hearings in 1979, Congress provided funding through the Engine Model Derivative Program (EMDP), a congressionally directed program, for General Electric to develop its F101 engine (which later became the F110) as an alternate engine for the F-16. DOD spent more than $376 million to develop the F110 to compete with the F100, and $600 million to improve the F100's durability and reliability to make it a stronger competitor.

The use of annual competitions for procuring engines for an aircraft procurement program was unprecedented and controversial. Proponents believe it produced better engines, on better terms, for less money than would purchasing from a single company facing no competition. Other observers believed it "unjustifiably jeopardized combat effectiveness and pilot survivability."[101] Most of the studies have concluded that contractor responsiveness—not dollar savings—was the primary benefit of the competition. Testimony presented at a 1984 hearing suggested that requiring General Electric and Pratt and Whitney to compete for annual production and O&S work generated benefits for DOD in areas such as better contract terms and conditions, better warranties to assure engine quality, consistency, and long term stability of support.[102] A 1987 assessment stated that after competition was introduced, the incumbent (Pratt and Whitney) offered "engine improvements to the Air Force earlier than the Air Force had been led to expect without the competition."[103]

The benefits of the Great Engine War have been attributed in part to the particulars of how the engine competition was managed. Prior to the first contract award, for example, the Air Force

[98] This section presents, in edited form, material from an earlier CRS report on the alternate engine program – CRS Report RL33390, *Proposed Termination of Joint Strike Fighter (JSF) F136 Alternate Engine*, by Christopher Bolkcom.

[99] After 1994, Pratt and Whitney and GE continued to compete for engine business among foreign air forces that operated the F-16 and F-15.

[100] The F100 was the most advanced engine ever developed at that time, and its developed was rushed to meet a deadline for initial fielding of the F-15. In addition, one report notes that "[t]he F100 engine was so powerful and the F-15 so maneuverable that pilots began pushing the aircraft to the edge of the performance envelope in ways that stressed the engine far more than had been anticipated." (Karl G. Amick, *The Next Great Engine War: Analysis and Recommendations for Managing the Joint Strike Fighter Engine Competition*, Naval Postgraduate School, Monterey, CA. 2005, p. 8.) Mounting frustrations over Pratt & Whitney's reluctance to fully address the F100's shortcomings without additional funding resulted in the Air Force, Navy, and Congress working in concert to fund work on an alternate engine. (Ibid, p. 92-98)

[101] Robert W. Drewes, *The Air Force and the Great Engine War*, National Defense University Press, Washington DC, 1987.

[102] U.S. Congress, House, Committee on Armed Services, *Air Force Alternative Fighter Engine, Hearings before the Subcommittee on Procurement and Military Nuclear systems*, 98th Cong. 2nd Sess., March 8, 1984.

[103] Robert W. Drewes. *The Air Force and the Great Engine War*. NDU Press (Washington, DC) 1987.

demanded that General Electric and Pratt and Whitney provide six years of cost projections to include the production of engines, support equipment, spare engines, technical data and dual sourcing data and second sourcing data for operations and support (O&S). The contractors were held to these cost projections for six years: the Air Force let six years of firm-fixed price, or "not-to-exceed" contracts from the first production lot. Prior to the Great Engine War, government had succeeded in negotiating firm-fixed price contracts only after the engine had been operating in the field for several years. Never before had contractors agreed to provide cost projections into the future, and contracts were typically for production only, not O&S work. To avoid potential disruptions in production, and to protect itself against price gouging, DOD "required (each contractor) to provide his plan for providing dual sources of critical parts. These separately priced options in the proposals would allow the Government to reprocure spare parts from sources other than the prime contractors."[104]

Operational Risk

Those supporting an alternate engine note that F-35s are to constitute the majority of future U.S. fighters, and that using a single type of engine in all F-35s creates a risk of all F-35s being grounded in the event of a problem with that engine. The Marine Corps grounded 106 AV-8B Harriers in July 2000 after a faulty engine bearing was cited as the cause of a crash.[105] About 18% of the Navy's grounding bulletins from 1997 to 2006 were due to engine issues.[106] The Air Force has experienced two system-wide fleet stand-downs due to engine issues since 1990.[107]

DOD officials argue that terminating the F136 alternate engine program poses little operational risk. Past decisions to pursue alternate engines for Air Force F-15s and F-16s and Navy F-14s, they state, were made at a time when the services were dissatisfied with the performance of existing engines (the F100 and TF30). DOD argues that these same conditions do not exist today.

In a briefing provided to Congress in 2006, DOD's Office of Program Analysis and Evaluation (PA&E) stated the F135 engine was performing well. PA&E stated that the F-22's F119 engine, from which the F135 was derived, had performed well over roughly 18,000 flight hours, and that it would achieve 100,000 flight hours by 2009. The briefing also noted that the F-22 and the F/A-18E/F each use a single, sole-sourced engine (the Pratt and Whitney F119 and General Electric F414, respectively).[108] Skeptics might argue that 18,000 hours of operation is a relatively a modest foundation for making projections of the F119's future performance, compared to the 2 million hours of operational service that had accumulated on the F100 engine by 1984, when the decision was made to divide F-16 engine production contracts between the F100 and F110.

DOD argues that advances such as computational fluid design for airflow prediction and advanced software for prognostic health monitoring reduce the operational risks of relying on a single engine type for an aircraft.[109] Presumably, the advanced software will result in engines that

[104] Prepared Statement of Hon. Thomas Cooper. *Air Force Alternative Fighter Engine, Hearings* OpCit.

[105] Mark Oliva, "Pilots defend Harrier jet." *Stars and Stripes*. (Pacific Edition). January 19, 2003.

[106] Another 66% were due to airframe-related issues. ("JSF Engine Second Source Executive Summary," Whitney, Bradley, and Brown Consulting; December 2006. Slide 23.)

[107] Ibid.

[108] "JSF Alternate Engine Decision" Briefing. OSD/PA&E. February 27, 2006.

[109] Ibid.

can diagnose their own condition and notify the pilot of impending failure (as opposed to notifying pilots of a failure once it has occurred). Advanced warning of impending failures could give a pilot time to land prior to failure, and allow more-efficient and cost-effective maintenance procedures.

On August 30, 2007, and February 4, 2008, the F135 engine experienced testing failures while on the test stand. The JSF Joint Program Office stated that the engine failures in both cases were due to "high-cycle fatigue" resulting in the failure of a third-stage turbine blade.[110] A Navy official testified in 2008 that the second engine failure was as a result of ongoing testing to determine the causes of the first failure, that Pratt and Whitney appeared confident that it understood the root causes of the malfunctions, that a design fix was being developed and would be implemented once testing was complete.[111] DOD officials stated that these engine malfunctions delayed the expected first flight of the F-35B aircraft by a month or two. The engine failures and resulting delays may have contributed to a reported cost overrun of up to $850 million in the F135 program.[112]

Ending the F136 program might lead to a reduction in the number of suppliers for F-35 engine spare parts, potentially increasing the vulnerability of the F-35 engine spare parts supply chain to disruptions caused by labor disagreements or natural disasters. On the other hand, maintaining a competition between the F135 and F136 for the production of F-35 engines could reduce the workload for individual F135 suppliers and create uncertainty for both F135 and F136 suppliers regarding annual business volumes. One defense consulting firm stated in 2006 that approximately 50% of each engine is procured in a competitive environment today, suggesting that there are multiple vendors available that could create parts for each of the engines.[113] The IDA study of 2007 examined the top F136 component suppliers and concluded that it is "unlikely that any supplier would exit the domestic industrial base because of F136 termination."[114]

Size of F-35 Engine Production Run

The expected size of the F-35 production run can affect the potential for reaching a calculated break-even point for an alternate engine program. Other things held equal, the smaller the F-35 production run, the less potential there might be for reaching a break-even point; the larger the F-35 production run, the more potential there might be for reaching a break-even point. The size of the F-35 production run will be influenced by both U.S. decisions on the number of F-35s to be procured for the U.S. military, and decisions by foreign governments on the numbers of F-35s they want to purchase for their own militaries. Such decisions can be made (and changed) multiple times over the course of many years, during which time there could be multiple changes in the international security environment and U.S. and foreign defense budgets, making it potentially difficult to project now what the ultimate size of the F-35 production run might be.

[110] Jason Simpson. "Davis: JSF Program Office Anticipated Early-Stage Engine Problems." *Inside the Air Force*, February 15, 2008.

[111] CONGRESSIONAL TRANSCRIPTS. *Reuters*. Congressional Hearings. April 9, 2008. Senate Committee on Armed Services, Subcommittee on Airland, hearing on Fiscal Year 2009 Budget for Air Force and Navy Aviation programs..

[112] Tony Capaccio. "United Technologies F-35 Engine Over Cost Estimate." *Bloomberg.com*. July 21, 2008.

[113] Ibid. Slide 22. Note: See http://www.wbbinc.com on Whitney, Bradley, and Brown, their corporate profile and their clients.

[114] IDA JSF Final Report, p. 165.

Industrial Base

Since Pratt and Whitney and General Electric are the only two U.S. manufacturers of fighter aircraft engines, a potential issue for policymakers is what effect terminating the F136 engine might have on General Electric's ability to compete for future fighter aircraft engines.

General Electric has a significant share of the market for commercial aircraft engines. It also builds and maintains F400 series engines for the Navy and Marine Corps F/A-18E/F strike fighters and EA-18G electric attack aircraft, and supports the F110 series of engines for domestic and international clients. The CAIG and IDA studies of 2007 noted General Electric's strong position in the commercial engine market. The CAIG study stated that General Electric produced 1,000 commercial engines in 2007, while Pratt and Whitney produced 220 commercial engines.[115] The CAIG study noted that General Electric derives about 15% of its business from military engines, while Pratt and Whitney derives about 50% of its business from military engines.[116]

A key question is how sufficient General Electric's work on engines other than the F136 (including the F400 and F110 series military engines) would be for preserving General Electric's ability to design and produce fighter engines if the F136 program were terminated. The CAIG study of 2007 stated that about 200 General Electric military jet engineers would be unable to transfer their skills to General Electric's commercial engines if the F136 engine were terminated.

Although the IDA study of 2007 concluded that the U.S. industrial base may not be "irreparably harmed" if the F136 engine is terminated, the study expressed reservations about DOD placing all of its fighter engine production with a firm that has a weak position in the commercial marketplace, because a firm with a relatively small presence in the commercial marketplace would have fewer resources that could be leveraged for use on DOD products.[117] As mentioned earlier, the IDA study of 2007 examined the top F136 component suppliers and concluded that it is "unlikely that any supplier would exit the domestic industrial base because of F136 termination."[118] The IDA study concluded that, overall, the U.S. industrial base would be stronger as a result of an active F136 program.

One observer has argued that, in light of General Electric's strong overall position in the aircraft engine marketplace, participation by General Electric in the production of F-35 engines might weaken the industrial base for fighter engines by reducing the amount of fighter engine work going to Pratt and Whitney, which is more dependent than General Electric on military engine work. This observer stated that, during the period 2007-2016, General Electric is expected to produce more engines for F/A-18s than Pratt and Whitney is expected to produce for the fighter aircraft types that use its engines (the F-15, F-16, F-22, and F-35).[119]

[115] OSD Cost Analysis Improvement Group Report (v6), "F-35/JSF Alternate Engine Acquisition and Independent Cost Analyses," March 15, 2007, Slide 44.

[116] OSD Cost Analysis Improvement Group Report (v6), "F-35/JSF Alternate Engine Acquisition and Independent Cost Analyses," March 15, 2007, Slide 44.

[117] IDA JSF Final Report, p. 169.

[118] IDA JSF Final Report, p. 165.

[119] Loren Thompson. "Powering JSF—One Engine Is Enough." *Lexington Institute*, January 2008, pp. 14-15.

Some of those who participated in or studied the Great Engine War argue that the competition between General Electric and Pratt and Whitney made Pratt and Whitney and General Electric better and "proved invaluable to future engine development."[120]

Relations with Allies

A Memorandum of Understanding (MOU) between the United States and eight other countries on the production, sustainment, and follow-on development of the JSF that was signed by the United States on November 14, 2006, states in Section III, regarding Scope of Work (paragraph 3.2.1.1), that

> The production work [of the JSF Air System] will include, but will not be limited to, the following...
>
> Production of the JSF Air Vehicle, including propulsion systems (both F135 and F136).[121]

In response to a question from CRS on whether this MOU has been superseded or changed, the Air Force states:

> The Joint Strike Fighter (JSF) System Development and Demonstration (SDD) Memorandum of Understanding (MOU) scope of work includes development of JSF primary and alternate propulsion systems which – consistent with the provisions used in all Department of Defense development, acquisition, and support MOUs – is ultimately subject to the availability of U.S. and partner nation funds for such purposes. The PSFD MOU provision (para 3.2.1.1.) regarding cooperative production and procurement of F135 and F136 remains valid. The Department will continue to implement both its JSF SDD and PSFD MOU obligations subject to availability of U.S. and partner funds. We have engaged in consultations with our partners on the Administration's decision not to include F136 in its RDT&E funding requests. The partners are awaiting the outcome of the U.S. FY10 defense authorization and appropriation process, and any further consultations with the Department that may be required on this matter. We do not plan to amend either the JSF SDD MOU or PSFD MOU regardless of the outcome of the U.S. FY10 authorization and appropriation process.[122]

The UK's top defense procurement official reportedly stated in 2006 that his country would cease participation in the F-35 program if the F136 engine were cancelled and technology transfer issues were not resolved to the UK's satisfaction.[123] A member of the UK House of Commons

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[120] Maj. John Nix and Maj. Riley Shelnutt. "Behind the Alternate Fighter Engine Competition." *Aerospace America.* May 1984.

[121] Memorandum of Understanding among the Department of Defence of Australia and the Minister of National Defence of Canada and the Ministry of Defence of Denmark and the Ministry of Defence of the Republic of Italy and the State Secretary of Defence of the Kingdom of the Netherlands and the Ministry of Defence of the Kingdom of Norway and the Undersecretariat for Defense Industries on behalf of the Ministry of National Defense of the Republic of Turkey and the Secretary of State for Defence of the United Kingdom of Great Britain and Northern Ireland and the Secretary of Defense on behalf of the Department of Defense of the United States of America Concerning the Production, Sustainment, and Follow-on Development of the Joint Strike Fighter (Short Title – JSF PSFD MOU), p. 16. The MOU was provided to CRS on September 17, 2009, by the Air Force legislative affairs office.

[122] Source: Untitled information paper on JSF PSFD MOU provided to CRS by Air Force legislative liaison office, September 21, 2009.

[123] Megan Scully, "British Demand Better Access To Fighter." *National Journal's Congress Daily AM*, March 15, 2006. George Cahlink. "U.K. Procurement Chief Warns Backup Engine Dispute Threatens JSF Deal." *Defense Daily*, (continued...)

reportedly stated in 2006 that a DOD decision to end the F136 would "invariably effect future procurement decisions, with seriously negative consequences that may not be fully appreciated on this side of the Atlantic." He reportedly stated that "without doubt, cancellation of the program would play into the hands of those in Europe who are even now all too willing to suggest the U.S. cannot be relied on and that Britain should look instead to France and European institutions on defense."[124]

Other European countries, such as the Netherlands, have firms that participate in both the F135 and F136 programs.[125] As European companies secure more F-35-related contracts, the debate within each of the partner nations over the need for the second engine might become more complicated.

F-35 Development Status and Readiness for High-Rate Production

Another issue for Congress for the F-35 program in FY2010 concerns the development status of the F-35 and whether the aircraft is ready to shift into higher rate production.

Administration Perspective

At a May 20, 2009, hearing before the Air and Land Forces subcommittee of the House Armed Services Committee on Air Force acquisition programs, a DOD acquisition official stated:

> The decision to increase the six-year F-35 production profile by 28 aircraft was driven by the need to create a more efficient ramp-rate from year to year as we prepare to enter full-rate production in the 2015 timeframe. Accelerating the 28 aircraft deliveries into the Fiscal Years 2010-2015 FYDP lowers the unit cost, expedites delivery of aircraft to the warfighter, and has the added benefit of saving approximately $500 million over the life of the program. More importantly, appropriately managing the investments in this ramp-rate is critical to meeting our warfighter requirements at the lowest possible cost to the taxpayer. The current state of the flight test schedule was considered in making this decision. The developmental flight testing begins in earnest this year, with operational testing not scheduled to begin until 2012. While flight testing is an important part of the program, it is not the only indicator of performance verification. Design maturity, manufacturing quality metrics, and software stability are providing confidence through initial structural testing, limited flight envelope testing, and predicted versus actual performance in the large number of labs and simulators. The Department believes that the investment now, to achieve a more efficient production ramp, will yield savings over the long term and ensure the Services receive the warfighting assets they need to execute their operational requirements.[126]

At the same hearing, Air Force officials stated the following:

(...continued)

March 15, 2006.

[124] Rodney L. Pringle, "JSF Engine Rumblings," *Military Aerospace Technology*, October 8, 2006.

[125] Joris Janssen Lok. "Double Dutch; Pratt, Rolls Involve More Dutch Partners in F135, F136 Programs," *Aviation Week & Speace Technology*, February 11, 2008.

[126] Statement of Mr. David G. Ahern, Director, Portfolio Systems Acquisition, Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics), Before the House Armed Services Committee Subcommittee on Air and Land Forces, May 20, 2009, p. 7.

> The F-35 is projected to meet all Key Performance Parameters (KPP) and as of 10 May 2009, AA-1 [an F-35 SDD aircraft] has completed 84 test flights, including a deployment to Eglin AFB. The first system design and development (SDD) Short Take-Off and Vertical Landing (STOVL) aircraft, BF-1, has completed 14 flights. The second SDD STOVL aircraft, BF-2, had its first flight in February 2009. The Cooperative Avionics Test Bed (CAT-B) continues to provide unprecedented risk reduction at this stage in a major weapon system not seen in any legacy program. In December 2008, the Defense Acquisition Executive (DAE) approved full funding for 7 Conventional Take-Off and Landing (CTOL) aircraft and engines, plus sustainment and associated equipment as part of the Low Rate Initial Production (LRIP) Lot 3 acquisition decision memorandum. In addition, the DAE approved full funding for seven STOVL aircraft plus sustainment and associated equipment contingent upon successful completion of the F135 Pratt & Whitney lead engine Stress Test, Flight Test Engine 6 Proof Test and receipt of full STOVL flight clearance, which occurred on 30 January 2009.[127]

At a May 19, 2009, hearing before the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee on Department of the Navy aviation procurement programs, Navy and Marine Corps Officials stated:

> Three SDD jets (AA-1, BF-1 and BF-2) are in flight testing. The remaining SDD jets and ground test articles, plus Low Rate Initial Production (LRIP) I and LRIP II aircraft, are in various stages of production. The SDD jets are setting new standards for quality and manufacturing efficiencies that improve with each jet. In flight testing, the initial Conventional Takeoff and Landing (CTOL) aircraft (AA-1) has demonstrated superb performance and reduced program risk, with 81 sorties (~111 flight hours) flown through April 20, 2009. BF-1, the first STOVL flight test jet, first flew in June 2008, on the schedule established two-years prior. BF-1 has flown 14 flights (~13 hours), and is currently on the hover pit, undergoing vertical engine operations. BF-2 first flew February 2009 and returned with no flight discrepancies noted. BG-1 static test results are favorable. The F135 engine has completed 11,300+ test hours on 16 engines through mid-April 2009. Software is 74% complete, with 13 million lines of code released including Block 0.5 Mission Systems, per the spiral development plan/schedule and with record-setting code-writing efficiencies. Software demonstrates stability across multiple Mission System subsystems.
>
> Systems integration testing continues on plan via flight tests, a flying lab and over 150,000 hours of ground labs testing. A fully integrated Mission Systems jet will fly later this year. The second production lot contract was signed below the cost model prediction. LRIP III contract negotiations are near complete, and LRIP IV Advance Procurement funding is on contract. All F-35 variants are projected to meet their respective Key Performance Parameters. The F-35 plan for incremental blocks of capability balances cost, schedule and risk.[128]

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[127] Department of the Air Force Presentation to the House Armed Services Committee Subcommittee on Air and Land Forces, United States House of Representatives, Subject: Air Force Programs, Combined Statement of: Lieutenant General Daniel J. Darnell, Air Force Deputy Chief Of Staff For Air, Space and Information Operations, Plans And Requirements (AF/A3/5) [and] Lieutenant General Mark D. Shackelford, Military Deputy, Office of the Assistant Secretary of the Air Force for Acquisition (SAF/AQ) Lieutenant General Raymond E. Johns, Jr., Air Force Deputy Chief of Staff for Strategic Plans And Programs (AF/A8) May 20, 2009, pp. 10-11.

[128] Statement of Vice Admiral David Architzel, USN, Principal Military Deputy, Research, Development and Acquisition, LTGEN George J. Trautman III, USMC, Deputy Commandant for Aviation, [and] RADM Allen G. Myers, USN, Director of Warfare Integration, Before the Seapower and Expeditionary Warfare [sic: Forces] Subcommittee of the House Armed Services Committee [hearing] on [the] Department of the Navy's Aviation Procurement Program, May 19, 2009, p. 2.

GAO Perspective

March 2009 GAO Report

A March 2009 Government Accountability Office (GAO) report providing assessments of major DOD weapon acquisition programs stated the following about the F-35 program:

> **Technology Maturity**
>
> Five of the JSF's eight critical technologies are mature. The remaining three—mission systems integration, prognostics and health management, the radar—are approaching maturity.
>
> **Design Maturity**
>
> The program reported that it had released over 90 percent of planned engineering drawings for each of the three variants indicating that the designs are generally stable. While the designs appear stable, the late release of design drawings led to manufacturing inefficiencies from which the program is still recovering.
>
> **Production Maturity**
>
> The JSF program's production processes are not mature. While the program collects information on the maturity of manufacturing processes, a good practice, only about 12 percent of its critical manufacturing processes are in statistical control. Projected labor hours have increased about 40 percent since 2007. The late release of drawings and subsequent supplier problems have led to late part deliveries, delaying the program schedule and forcing inefficient manufacturing processes. Program officials do not expect these inefficiencies to be fully corrected until 2010, during its third low rate production lot.
>
> The JSF designs are still not fully proven and tested. Flight testing, begun in late 2006, was only about two percent completed as of November 2008. The program began testing its first production representative prototype—a short takeoff vertical landing variant flown in conventional mode—in June 2008. A fully integrated, capable aircraft is not expected to enter flight testing until 2012, increasing risks that problems found may require design and production changes and retrofits of completed aircraft.
>
> **Other Program Issues**
>
> The program continues to experience significant cost increases and schedule delays. A recent independent cost estimate identified additional funding requirements for system development of as much as $7.44 billion through fiscal year 2016. This would increase the total development costs 14 percent from $44.3 billion to $51.81 billion. The estimating team also projected a three year extension in system development. Separately, the program office has projected that development costs will increase by approximately $2.43 billion to address cost overruns on the airframe and engine contracts and to pay for a one-year schedule extension. The independent cost estimate was higher than the program office estimate because it also included (1) the alternate engine effort, (2) higher contractor engineering staff levels, (3) additional software growth, (4) an expanded flight test program, and (5) more labor hours to manufacture aircraft. Program officials argue that costs will be lower than the independent estimate because, among other things, they believe the program has made substantial progress in software development and has invested heavily in advanced simulation labs intended to reduce risk.

Despite the program's continued manufacturing problems and the infancy of the flight test program, DOD officials want to accelerate production by 169 aircraft between fiscal years 2010 and 2015. This may require up to $33.5 billion in additional procurement funding in those years. We believe this more aggressive production approach is optimistic and risky.

Program Office Comments

The program noted that JSF's technical, software, production processes, and testing maturity are tracking to plan and substantially exceeding standards set in past programs. The manufacturing fit and quality of the jets are unprecedented and production processes are improving with each jet. The program's second prototype test aircraft flew on the schedule established two-years prior. Software development is 65 percent complete (twelve million lines) in accordance with the spiral development plan/schedule and with record-setting code-writing efficiencies. The software demonstrates stability across multiple mission system subsystems. Systems integration testing continues on schedule through the use of flight tests, a flying lab, and over 150,000 hours of ground labs testing. A fully integrated mission systems jet is scheduled to fly in 2009. The latest DOD independent cost estimate increased little from the one of four years ago. The second production lot contract was signed for a price below the cost model prediction. The program's plan for incremental blocks of capability balances cost, schedule and risk.[129]

May 2009 GAO Testimony

At a May 20, 2009, hearing before the Air and Land Forces subcommittee of the House Armed Services Committee on Air Force acquisition programs, GAO testified on the F-35 program, stating:

JSF development will cost more and take longer to complete than reported to the Congress in April 2008, primarily because of contract cost overruns and extended time needed to complete flight testing. DOD is also significantly increasing annual procurement rates and plans to buy some aircraft sooner than reported last year. Total development costs are projected to increase between $2.4 billion and $7.4 billion and the schedule for completing system development extended from 1 to 3 years....

Manufacturing of development test aircraft is taking more time, money, and effort than planned, but officials believe that they can still deliver the 9 remaining test aircraft by early 2010. The contractor has not yet demonstrated mature manufacturing processes, or an ability to produce at currently planned rates. It has taken steps to improve manufacturing; however, given the manufacturing challenges, DOD's plan to increase procurement in the near term adds considerable risk and will be difficult to achieve.

DOD is procuring a substantial number of JSF aircraft using cost reimbursement contracts. Cost reimbursement contracts place most of the risk on the buyer—DOD in this case—who is liable to pay more than budgeted should labor, material, or other incurred costs be more than expected when the contract was signed.

JSF flight testing is still in its infancy and continues to experience flight testing delays. Nonetheless, DOD is making substantial investments before flight testing proves that the JSF

[129] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*. GAO-09-326SP, March 2009. p. 94.

will perform as expected. DOD may procure 273 aircraft costing an estimated $42 billion before completing flight testing.

Procurement Investments and Progress of Flight Testing

	2007	2008	2009	2010	2011	2012	2013	2014
Cumulative procurement (billions of dollars)	$0.9	$3.6	$6.9	$13.7	$20.6	$31.1	$41.9	$54.3
Cumulative aircraft procured	2	14	28	58	101	183	273	383
Percentage of flight test program completed	<1%	<1%	2%	9%	34%	62%	88%	100%

Source: GAO analysis of DOD data[130]

Press Reports

A June 2, 2009, press report states:

> Joint Strike Fighter officials are refocusing the program on delivering test-ready aircraft following further delays to completing F-35s for development flight-testing.
>
> The shift will delay the first flight of aircraft still in production by up to three months, but is expected to enable faster flight-testing to recover some of the slippage.
>
> Aircraft were previously being flown once, then grounded for modifications to incorporate design changes resulting from analysis and testing.
>
> "There was a lot of emphasis on first flight under past program leadership. The event became important, not the readiness [for testing]," says Doug Pearson, vice president of the F-35 integrated task force.
>
> "When there was more work to do on the aircraft, it was added after first flight. And over time, the additions became more than we wished for," he says. For example, aircraft BF-2 flew once in February and has been in modification since.
>
> New JSF program executive officer Brig. Gen. David Heinz has asked Lockheed Martin to study the effect of rephasing the work to accomplish the modifications on assembly before first flight.
>
> The ferry flight to the test center at Edwards Air Force Base in California or Naval Air Station Patuxent River in Maryland would become the new programmatic milestone. "We need to get them built, and ready to test, before they fly," Pearson says.

[130] Government Accountability Office, *Joint Strike Fighter[:]Strong Risk Management Essential as Program Enters Most Challenging Phase, Statement of Michael Sullivan, Director Acquisition and Sourcing Management*. GAO-09-711T, May 20, 2009, summary page.

> Instead of flying all the development F-35s by year's end, four of the aircraft would slip into 2010, Heinz says, but Lockheed hopes to recover some of the delay by delivering fully modified aircraft into productive flight-testing.
>
> Aircraft BF-1, the first short takeoff and vertical landing (STOVL) F-35B, is in modification following hover-pit testing and is expected to return to flight by the end of July.
>
> After around 12 flights from the Fort Worth, Texas, plant to verify design changes and qualify the aircraft for probe-and-drogue refueling, BF-1 is expected to ferry to Patuxent River at the end of August to begin STOVL "build down" flight-testing.
>
> Another 12-20 flights at progressively lower altitudes and speeds are expected to culminate in the first vertical land on the hover pad at Patuxent River in September/October.
>
> "I will be surprised if it goes beyond October," says Pearson, while describing it as an aggressive schedule. "There's a reasonable chance it will happen before the end of September."
>
> Aircraft BF-2 is due at Patuxent River in September while BF-4, the first F-35 mission-system test aircraft, is expected to arrive by year's end. BF-3 is a loads aircraft and will go though extensive ground testing before flying.
>
> Aircraft AF-1 and -2, the first production-representative conventional takeoff and landing F-35As, will be the next aircraft to fly, Pearson says. They are scheduled for delivery to the Edwards test center in the first quarter of next year.
>
> The first F-35C carrier variant, CF-1, is now scheduled to fly on Dec. 23, a slip of three months, with the other two test aircraft following early in 2010. All three will go to Patuxent River.
>
> Because of delays, the bulk of the 5,000-plus development flights will now be conducted in 2010 and 2011, but Pearson still expects to complete operational testing in 2014. The original schedule was 2013, but this was extended last year.[131]

A June 8, 2009, press report states:

> The Marine Corps short-take-off, vertical-landing (STOVL) variant of the Joint Strike Fighter is now slated to begin in-flight transition to the aircraft's lift fan in August, months later than originally intended, Brig. Gen. David Heinz, JSF program executive officer, said last week.
>
> There are still tests and modifications that need to be done on the first STOVL test aircraft, BF-1, before the ramp-down to full vertical flight can begin, Heinz said, adding that the delay to the aircraft would not have a significant impact on the testing schedule because the program has a cushion built in to absorb such setbacks. The tests were originally supposed to take place this spring.
>
> "Today I have programmed for the availability slots a ramp to get to 12 successful sorties per month per airplane," he said during a June 2 roundtable with reporters at the JSF program office in Arlington, VA. "If you take in aggregate every one of those airplanes sliding three

[131] Graham Warwick, "JSF Program Refocusing On Test-Ready Aircraft Deliveries," *Aerospace Daily & Defense Report*, June 2, 2009: 1-2. Material in brackets as in original.

> months before you deliver them to the flight test program, that only goes to 12.6 successful sorties."
>
> Heinz noted that it is a three-year test program and, at the end of this year, all 12 of the flight test vehicles for the Navy, Marine Corps and Air Force JSF variants will have been delivered. He said the program has already resourced for six flying days per week while his schedule calls for using only five.
>
> "First of all, 12.6 is really in the national average," he said. "The F/A-18E/F program accomplished about 13.1 ... so I'm not asking this huge leap."
>
> As it stands now, the BF-1 finished hover-pit testing and is undergoing modifications, which will end this month. The plane will begin a series of 12 flights transition from conventional flight to STOVL mode at the end of August, leading to its first full vertical landing about a month later, the general said.
>
> Heinz said he is not worried about the Pratt and Whitney-built F135 engine, which had high-cycle fatigue problems in the past year.
>
> "I'm not at all concerned about that," he said. "We've already done all the durability testing that proves out that that's going to work for the life of the motor."
>
> Heinz also pointed to the reliability of the aircraft and the software, which he claimed were performing very well.
>
> "I'm already achieving on the order of 80 flight hours before a software incident," he said.
>
> The program has also conducted 99 flights, and "77 of those flights have come back ready to fly the mission without work, and so that is a good indicator," he said.
>
> In all, the three JSF variants will fly about 5,000 test sorties over about 10,000 hours during the testing phase of the program.
>
> BF-1 began hover-pit testing in Fort Worth, TX, in March. Lockheed Martin will send the aircraft to Naval Air Station Patuxent River, MD, to begin full vertical flight tests.
>
> The aircraft has flown 14 times in conventional mode.[132]

An August 3, 2009, press report states:

> The Obama administration has directed a new review of the Joint Strike Fighter program, directing an "independent" Pentagon team—that last year found the F-35 program needed two additional years of development and more than $15 billion over the next six years—to update its findings in order to support Defense Department leaders preparing the fiscal year 2011 budget request.
>
> In a previously unreported July 10 memo, Deputy Defense Secretary William Lynn tasked the JSF Joint Estimate Team to reexamine the U.S. military's largest acquisition program and determine whether the stealth fighter—which is being developed for the Air Force, Navy

[132] Dan Taylor, "Heinz: Transition of JSF to STOVL Mode Will Not Begin Until August," *Inside the Navy*, June 8, 2009.

and Marine Corps, as well as eight international partners—requires significantly more time and money, according to sources familiar with the memo.

This assessment is being prepared as an alternative to the budget plans drawn up by the joint program office responsible for developing and procuring the F-35 Joint Strike Fighter.

Should the assessment produce findings similar to those last fall, it could present Pentagon leaders with politically difficult choices necessary to fully fund JSF—including terminating other weapons programs to harvest cash, seeking additional funds from Congress, or converting future procurement funds to finance development, which would reduce the size of the planned JSF fleet.

Last fall, Pentagon leaders sidestepped recommendations of the JSF Joint Estimate Team to recalibrate the funding and schedule of the F-35 program between fiscal years 2010 and 2015. The panel found the fighter program required two additional years and another $3.6 billion to develop the aircraft, as well as an additional $11.6 billion for procurement. Those findings were first reported on Nov. 26, 2008, by sister publication Inside the Air Force and Bloomberg News.

Instead, Pentagon leaders added $480 million to the JSF program in FY-10 to boost the testing program with the expectation that at some point during the middle of FY-10, the Pentagon would know which estimate was more accurate: the one prepared by the JSF Joint Program Office or the JSF JET.

The JET is led by the Pentagon's cost assessment and program analysis shop, formerly called the cost analysis improvement group, as well as the Air Force Cost Analysis Agency, and NAVAIR 4.2, the Navy's team of analysts who assess the cradle-to-grave cost of weapon systems.

The JET was formed in January 2008 at the request of the F-35 Joint Program Office. The Pentagon plans to acquire 2,456 JSF aircraft for the Navy, Marine Corps and Air Force at a cost of $298.8 billion—a sum that reflects cost growth of 44.4 percent over original estimates made in 2002, according to the Defense Department's most recent acquisition report to Congress.

The new JSF JET assessment is not the only review of the program's price tag being conducted, however.

Sue Payton, on April 7—her last day as Air Force acquisition executive—declared the "JSF program fiscal health is mixed" and recommended the Air Force Cost Agency prepare an independent estimate of the program cost in preparation for transitioning the management of the program from the Navy to the Air Force, ITAF reported.

InsideDefense.com recently obtained an 18-page copy of the JSF JET estimate used to brief Pentagon leaders on Sept. 9, 2008. The assessment found that the JSF would require an additional 1 million lines of software code above the 4.6 million lines of software code the program plans.

The JET found that, in light of experience with developing the F-22 fighter, the JSF Joint Program Office and prime contractor Lockheed Martin will not be able to significantly reduce engineering staff between FY-10 and FY-13 during system development from 4,100 to 1,000 "as F-35 testing is just beginning to provide performance information in this time."

> The JSF JET also found that procurement costs would be higher than the program office projects because "commonality of manufacturing and assembly of the three variants is largely lost."
>
> The JET "assumes 25 percent 'credit' for commonality vice the 82 percent by" Lockheed Martin and the Joint Program Office, according to the summary of the assessment.[133]

An August 18, 2009, press report states:

> One of the top Pentagon officials overseeing development of the F-35 joint strike fighter says program managers are confident that work is proceeding close to schedule and won't have any more significant delays.
>
> A team of Defense Department cost analysts, which a year ago predicted further delays and cost increases, has begun a new review of the F-35 development effort headed by Lockheed Martin.
>
> Air Force Brig. Gen. C.D. Moore, deputy program executive officer for the F-35 program office, responded in writing to questions from the Star-Telegram about the program's status.
>
> A year ago, the Joint Estimating Team (JET) predicted that it would take two years longer and at least $3 billion more to complete development and testing of the F-35, plus an additional $11 billion to reach planned procurement levels. The program office disagreed. Do you still disagree with that assessment?
>
> The F-35 program team remains confident in its ability to deliver to commitments within the baseline program. The program continues to make excellent progress as demonstrated by an ongoing reduction of technical risk, successful maturation of processes and systems, and effective cost controls.
>
> The F-35's most critical technologies are reaching maturity with all variant hardware designs nearing completion and software development more than 70 percent complete. Our integrated laboratory and flying test beds have identified and retired risks well before flight test at a rate unprecedented in previous aircraft development programs.
>
> Eighty percent of test flights have concluded with no unplanned maintenance requirements—a reliability rate that would be high for an operational fleet. Manufacturing precision is the best ever for a new fighter at this stage of production, with notable improvements in quality and processes as more aircraft enter production.
>
> The JET estimate projected completion of the developmental and operational test phases by 2016 versus the [program office] estimate of 2014. The [Defense] Department added $476 million [in the fiscal 2010 budget request] to address near-term risks ... and agreed there were a number of critical events/milestones during FY09 and FY10 that would provide a better assessment of which estimate was more accurate.
>
> Is the contractor team performing as planned and expected, given that key deadlines seem to have slipped considerably from the schedule put forth last year?

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[133] Jason Sherman and Marcus Weisgerber, "Obama Administration Directs Update Of JSF JET Estimate," *Inside the Navy*, August 3, 2009. See also Dan Taylor, "Crowley: JET Will Meet With Lockheed In Fall To Discuss JSF Issues," *Inside the Navy*, August 3, 2009; Graham Warwick, "Pentagon Reassessing F-35 Development Cost Estimates," *Aerospace Daily & Defense Report*, August 30, 2009: 1.

> Despite the challenges inherent on this complex development program, the F-35 government/contractor team continues to perform effectively in meeting key schedule milestones, as we prepare to field the entire fleet of developmental test aircraft over the next year, as well as deliver the first production aircraft next summer.
>
> Flight test flight activity has dropped well behind the revised schedule, roughly six months behind at this point. Is there a good explanation for why? Is this delay going to have a domino effect, or can delays be made up?
>
> The test articles have taken longer to build than planned, primarily due to late parts and configuration changes. Production delays for each of the test jets averages [about] three months.
>
> A variety of mitigation actions have been taken to eliminate schedule delays for future production deliveries. We have also taken measures to address the later than desired delivery of the test aircraft, and based on quantity of test assets, projected fly rates and experience to date in flight/lab testing, we're optimistic that the planned test program remains executable within the baseline schedule.
>
> What are the target dates now for initial operational capability (IOC)—for the F-35 to be in use with the U.S. armed forces?
>
> Planned IOCs remain 2012, 2013, and 2015 for the Marines, Air Force and Navy, respectively.[134]

Affordability and Projected Fighter Shortfalls

An additional potential issue for Congress for the F-35 program concerns the affordability of the F-35, particularly in the context of projected shortfalls in both Air Force fighters and Navy and Marine Corps strike fighters.

Although the F-35 was conceived as a relatively affordable strike fighter, some observers are concerned that, in a situation of constrained DOD resources, F-35s might not be affordable in the annual quantities planned by DOD, at least not without reducing funding for other DOD programs. As the annual production rate of the F-35 increases, the program will require more than $10 billion per year in acquisition funding at the same time that DOD will face other budgetary challenges. The issue of F-35 affordability is part of a larger and longstanding issue concerning the overall affordability of DOD's tactical aircraft modernization effort, which also includes procurement of F-22s (through FY2009, at least), and F/A-18E/Fs (through FY2012, at least).[135] Some observers who are concerned about the affordability of the F-35 in the numbers desired by DOD have suggested procuring upgraded F-16s as complements or substitutes for F-35As for the Air Force, and F/A-18E/Fs as complements or substitutes for F-35Cs for the Navy. F-35 supporters argue that F-16s and F/A-18E/Fs are less capable than the F-35, and that the F-35 is designed to have reduced life-cycle operation and support (O&S) costs.

[134] Bob Cox, "F-35 Is On track, Says Pentagon Officer," *Fort Worth Star-Telegram*, August 18, 2009: 1C. Ellipses as in original.

[135] For more on this issue, see CRS Report RL33543, *Tactical Aircraft Modernization: Issues for Congress*, by Ronald O'Rourke.

The issue of F-35 affordability occurs in the context of a projected shortfall of up to 800 Air Force fighters that was mentioned by Air Force officials in 2008,[136] and a projected shortfall of more than 100 (and perhaps more than 200) Navy and Marine Corps strike fighters.[137] Observers concerned about the affordability of the F-35 might argue that an inability to procure F-35s in desired numbers could contribute to these projected shortfalls. Supporters of the F-35 might argue that, as a relatively affordable aircraft that can be procured in highly common versions for the Air Force, Marine Corps, and Navy, the F-35 represents the most economical and cost-effective strategy for avoiding or mitigating such shortfalls.[138] Air Force officials testified in 2008 that they wish to double F-35 purchases over the next five years to alleviate the projected Air Force shortfall.[139] An August 3, 2009, news report states:

> Lockheed Martin officials told Chief of Naval Operations Adm. Gary Roughead last week that the company could ramp up the production of F-35 Joint Strike Fighters by as much as 30 additional Navy aircraft over the future years defense plan (FYDP), according to the program manager.
>
> Earlier this year, the Pentagon had proposed a modest increase of 28 aircraft between fiscal years 2010 and 2015. Lockheed, however, can add between 20 and 30 additional Navy JSFs to that over the FYDP to help alleviate a projected strike fighter gap next decade, Dan Crowley, Lockheed executive vice president and F-35 program manager, told reporters here July 28 following a roll-out ceremony for the first aircraft carrier variant test aircraft, CF-1.
>
> "We have a chart that we showed the CNO today, and it shows how much excess capacity could be applied to an accelerated Navy buy if they chose to do so," he said. "Over the FYDP, I think their request was something like 20 to 30 jets that you could add for the Navy, so we're not going to solve the whole strike fighter gap ... but we've provided that data to the Navy and now they'll use it in the QDR [Quadrennial Defense Review]."

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[136] Testimony of Lieutenant General Daniel Darnell, Deputy Chief of Staff, Air, Space and Information Operations, Plans and Requirements, before an April 9, 2008, hearing on Air Force and Navy aviation programs before the Airland subcommittee of the Senate Armed Services Committee. (Source: Transcript of hearing.)

[137] For more on the projected Navy-Marine Corps strike fighter shortfall, see CRS Report RL30624, *Navy F/A-18E/F and EA-18G Aircraft Procurement and Strike Fighter Shortfall: Background and Issues for Congress*.

[138] There have also been strong differences of opinion over how F-35 costs are calculated and presented. DOD's estimate of the total acquisition cost of the F-35 program, for example, shows the overall cost decreasing from $299 billion in December 2006 to $298 billion in December 2007. Some observers suggested that these figures were misleading, because the largest savings reported by DOD in the December 2007 report were achieved not by improvements in design or manufacture, but instead by moving costs from one category to another. (David Fulghum, "Dueling Analyses; Questions Remain About the Fundamental Soundness of Top Pentagon Programs," *Aviation Week & Space Technology*, April 14, 2008.) The GAO offered strong criticism of JSF cost estimates, writing that they were not comprehensive, not accurate, not well documented, nor credible. (Government Accountability Office, *Joint Strike Fighter[:]Recent Decisions by DOD Add to Program Risks*, GAO-08-388, March 2008, summarized on pp. 3-4 and addressed in detail throughout the report.) In summary, GAO noted that the JSF cost estimates did not include $7 billion for the F136 engine, and that the official JSF cost estimates are at odds with estimates made by three independent DOD agencies. JSF supporters disputed the GAO's findings, arguing that the program office's cost models are more reliable than those used by other organizations. (Amy Butler, "Cost Question," *Aviation Week & Space Technology*, July 14, 2008.) GAO is not the only organization to question the JSF cost estimates. An internal DOD organization—the Joint Estimate Team or JET—has argued that the JSF program will cost $15 billion more than official DOD cost projections. (Marcus Weisgerber, "'Independent' DOD Assessment Finds JSF Underfunded by $15 Billion," *Inside the Air Force*, November 28, 2008.)

[139] John Reed, "Air Force Working To More Than Double The Pace Of F-35 Purchases," *Inside the Air Force*, July 25, 2008.

> The Pentagon is looking at increasing the peak rate of JSF production from 80 to 110 per year in the Air Force and from 50 to 60 per year for the Navy, Crowley said.
>
> "Our thought is the Navy will use this data, they'll use pricing information and they'll do their own analysis," he said. "There's been no commitment to buy more than the plan of record."
>
> Overall, Lockheed could handle production of up to 250 per year at the factory in Fort Worth "if they decided they wanted to go full-bore," he said.
>
> Defense Secretary Robert Gates called for a total of 513 JSFs over the FYDP during an April 6 Pentagon briefing, less than a 6 percent increase over the original plan of 485 aircraft and a far cry from the 169 the program was seeking before the announcement.
>
> Brig. Gen. David Heinz, the JSF program manager, said earlier this year that he did not anticipate any difficulty in accommodating the modest increase, arguing that it may even help "flatten out the ramp" from the fifth to the sixth low-rate initial production lots.
>
> Crowley said the ramp-up would be just one part of a number of efforts to mitigate a projected strike fighter shortfall that is expected to peak at 243 aircraft as early as 2015. The Navy is also relying on extending the lives of up to 300 aging legacy F/A-18A-D Hornets to 10,000 hours, and the service is mulling the possibility of entering into another multiyear deal with Boeing to buy more F/A-18E/F Super Hornets.
>
> "My sense is that the Navy intends to solve [the gap] through multiple actions," Crowley said.[140]

Implications for Industrial Base

Another potential issue for Congress regarding the F-35 program concerns its potential impact on the U.S. tactical aircraft industrial base. The October 2001 award of the F-35 SDD contract to a single company (Lockheed) raised concerns in Congress and elsewhere that excluding Boeing from this program would reduce that company's ability to continue designing and manufacturing fighter aircraft.[141]

Similar concerns regarding engine-making firms have been raised since 2006, when DOD first proposed (as part of the FY2007 budget submission) terminating the F136 alternate engine program. Some observers are concerned that that if the F136 were cancelled, General Electric would not have enough business designing and manufacturing fighter jet engines to continue competing in the future with Pratt and Whitney (the manufacturer of the F135 engine). Others argued that General Electric's considerable business in both commercial and military engines was sufficient to sustain General Electric's ability to produce this class of engine in the future.

Exports of the F-35 could also have a strong impact on the U.S. tactical aircraft industrial base through export. Most observers believe that the F-35 could potentially dominate the combat

[140] Dan Taylor, "Lockheed Tells Roughead It Can Handle 30 Additional JSFs Over FYDP," *Inside the Navy*, August 3, 2009. See also "More F-35s?" *Aerospace Daily & Defense Report*, August 3, 2009: 1; and "F-35C Acceleration?" *Defense Daily*, August 3, 2009: 2.

[141] For more information, see CRS Report RL31360, *Joint Strike Fighter (JSF): Potential National Security Questions Pertaining to a Single Production Line*, by Christopher Bolkcom and Daniel H. Else.

aircraft export market, much as the F-16 has. Like the F-16, the F-35 appears to be attractive because of its relatively low cost, flexible design, and promise of high performance. Competing fighters and strike fighters, including France's Rafale, Sweden's JAS Gripen, and the European Typhoon, are positioned to challenge the F-35 in the fighter export market.

Some observers are concerned that by allowing foreign companies to participate in the F-35 program, DOD may be inadvertently opening up U.S. markets to foreign competitors who enjoy direct government subsidies. A May 2004 GAO report found that the F-35 program could "significantly impact" the U.S. and global industrial base.[142] GAO found that two laws designed to protect segments of the U.S. defense industry—the Buy American Act and the Preference for Domestic Speciality Metals clause—would have no impact on decisions regarding which foreign companies would participate in the F-35 program, because DOD has decided that foreign companies that participate in the F-35 program, and which have signed reciprocal procurement agreements with DOD to promote defense cooperation, are eligible for a waiver.

Legislative Activity for FY2010

Summary of Quantities and Funding

Table 3 summarizes congressional action on F-35 FY2010 procurement quantities and procurement and research and development funding levels.

Table 3. Summary of Action on FY2010 F-35 Quantities and Funding

Funding figures in millions of dollars, rounded to nearest tenth

		Authorization Bill (H.R. 2647/S. 1390)				Appropriations Bill (H.R. 3326)		
	Request	HASC report	SASC report	As amended on Senate floor	Conference report	HAC report	SAC report	Conference report
Procurement quantities								
F-35As (Air Force)	10	9	10	10	10	10	10	
F-35Bs (Marine Corps)	16	15	16	16	16	14	16	
F-35Cs (Navy)	4	4	4	4	4	4	4	
Total	30	28	30	30	30	28	30	
Procurement funding								
Air Force procurement funding	2,048.8	2,115.8	2,048.8	2,048.8	2,178.8	2,067.4	2,048.3	

[142] General Accountability Office, *Joint Strike Fighter Acquisition: Observations on the Supplier Base*, GAO-04-554, May 2004.

			Authorization Bill (H.R. 2647/S. 1390)			Appropriations Bill (H.R. 3326)	
Air Force advance procurement funding	300.6	313.6	300.6	300.6	278.6	278.6	278.6
Navy procurement funding	3,997.0	3,875.0	3,997.0	3,997.0	3,997.0	3,576.4	3,997.0
Navy advance procurement funding	481.0	486.0	481.0	481.0	481.0	481.0	481.0
Research and development funding							
Air Force	1,858.1	2,011.6	1,999.5	1,858.1	2,073.1	2,073.1	1,780.1
Navy	1,741.3	1,894.8	1,882.7	1741.3	1,956.3	1,956.3	1,663.3

Source: Prepared by CRS based on committee reports, bill text, and floor amendments.

FY2010 Defense Authorization Bill (H.R. 2647/S. 1390)

House

Quantities and Funding

The House Armed Services Committee's report (H.Rept. 111-166 of June 18, 2009) on H.R. 2647 recommends the following:

- procuring 19 F-35Bs and Cs for the Marine Corps and Navy—a reduction of one aircraft from the requested figure of 20 (page 57);
- procuring nine F-35As for the Air Force—a reduction of one aircraft from the requested figure of 10 (page 93);
- a net reduction of $122 million in Navy aircraft procurement funding for the procurement of F-35Bs and Cs for the Marine Corps and Navy, consisting of a reduction of $164 million for the one-aircraft reduction and an addition of $42 million for the F136 alternate engine (page 57; line 006);
- an increase of $5 million in Navy aircraft advance procurement funding for the F136 alternate engine (page 57, line 007);
- a decrease of $4 million in procurement funding for F-35 spares, and an increase of $2 million in procurement funding for F136 spares (page 60, line 057);
- a net reduction of $67 million in Air Force procurement funding for the procurement of F-35As for the Air Force, consisting of a reduction of $131 million for the one-aircraft reduction, a reduction of $9 million for F-35 initial spares, an increase of $57 million for the F136 alternate engine, an increase of $21 million for spares for the F136 alternate engine, and an increase of $129 million for F-35 spares and support equipment (page 93; line 001);

- an increase of $13 million in Air Force advance procurement funding for the F136 alternate engine (page 93; line 002);
- a net increase of $153.5 million in Navy research and development funding for the F-35 program, consisting of an increase of $231.5 million for the F136 alternate engine and a reduction of $78 million for "program excess" (page 169); and
- a net increase of $153.5 million in Air Force research and development funding for the F-35 program, consisting of an increase of $231.5 million for the F136 alternate engine and a reduction of $78 million for "program excess" (page 190).

As discussed below in the section on report language, the recommended one-aircraft reduction in the number of F-35Bs and Cs to be procured is for an F-35B, making for a recommended procurement of 15 F-35Bs and 4 F-35Cs.

Legislative Provisions

H.R. 2647 contains four sections relating directly to the F-35 program—Section 214, which concerns the display of funding for F-35Bs and Cs in budget materials; Section 218, which limits the obligation of FY2010 F-35 research and development funds until certain conditions (including one related to the alternate engine program) are met; Section 232, which requires an annual GAO report on the F-35 program; and Section 242, which concerns the alternate engine program.

A fifth provision—Section 133—requires a report on the procurement of "4.5"-generation aircraft. The report is to include, among other things, "a discussion regarding the availability and feasibility of F-35s in fiscal years 2015 through fiscal year 2025 to proportionally and concurrently recapitalize the Air National Guard."'

The texts of these five provisions appear below.

Section 214 states:

> SEC. 214. SEPARATE PROCUREMENT AND RESEARCH, DEVELOPMENT, TEST AND EVALUATION LINE ITEMS AND PROGRAM ELEMENTS FOR THE F-35B AND F-35C JOINT STRIKE FIGHTER AIRCRAFT.
>
> In the budget materials submitted to the President by the Secretary of Defense in connection with the submission to Congress, pursuant to section 1105 of title 31, United States Code, of the budget for fiscal year 2011, and each subsequent fiscal year, the Secretary shall ensure that within the Navy research, development, test, and evaluation account and the Navy aircraft procurement account, a separate, dedicated line item and program element is assigned to each of the F-35B aircraft and the F-35C aircraft, to the extent such accounts include funding for each such aircraft.

Section 218 states:

> SEC. 218. LIMITATION ON OBLIGATION OF FUNDS FOR F-35 LIGHTNING II PROGRAM.
>
> Of the amounts authorized to be appropriated or otherwise made available for fiscal year 2010 for research, development, test, and evaluation for the F-35 Lightning II program, not

more than 75 percent may be obligated until the date that is 15 days after the later of the following dates:

(1) The date on which the Under Secretary of Defense for Acquisition, Technology, and Logistics submits to the congressional defense committees certification in writing that all funds made available for fiscal year 2010 for the continued development and procurement of a competitive propulsion system for the F-35 Lightning II have been obligated.

(2) The date on which the Secretary of Defense submits to the congressional defense committees the report required by section 123 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 (P.L. 110-417; 122 Stat. 4376).

(3) The date on which the Secretary of Defense submits to the congressional defense committees the annual plan and certification for fiscal year 2010 required by section 231a of title 10, United States Code.

Section 232 states:

SEC. 232. ANNUAL COMPTROLLER GENERAL REPORT ON THE F-35 LIGHTNING II AIRCRAFT ACQUISITION PROGRAM.

(a) Annual GAO Review- The Comptroller General shall conduct an annual review of the F-35 Lightning II aircraft acquisition program and shall, not later than March 15 of each of 2010 through 2015, submit to the congressional defense committees a report on the results of the most recent review.

(b) Matters to Be Included- Each report on the F-35 program under subsection (a) shall include each of the following:

(1) The extent to which the acquisition program is meeting development and procurement cost, schedule, and performance goals.

(2) The progress and results of developmental and operational testing and plans for correcting deficiencies in aircraft performance, operational effectiveness, and suitability.

(3) Aircraft procurement plans, production results, and efforts to improve manufacturing efficiency and supplier performance.

Section 242 states:

SEC. 242. INCLUSION IN ANNUAL BUDGET REQUEST AND FUTURE-YEARS DEFENSE PROGRAM OF SUFFICIENT AMOUNTS FOR CONTINUED DEVELOPMENT AND PROCUREMENT OF COMPETITIVE PROPULSION SYSTEM FOR F-35 LIGHTNING II.

(a) Annual Budget- Chapter 9 of title 10, United States Code, is amended by adding at the end the following new section:

`Sec. 235. Budget for competitive propulsion system for F-35 Lightning II

`(a) Annual Budget- Effective for the budget of the President submitted to Congress under section 1105(a) of title 31, United States Code, for fiscal year 2011 and each fiscal year thereafter, the Secretary of Defense shall include, in the materials submitted by the Secretary to the President, a request for such amounts as are necessary for the full funding of the

continued development and procurement of a competitive propulsion system for the F-35 Lightning II.

`(b) Future-Years Defense Program- In each future-years defense program submitted to Congress under section 221 of this title, the Secretary of Defense shall ensure that the estimated expenditures and proposed appropriations for the F-35 Lighting II, for each fiscal year of the period covered by that program, include sufficient amounts for the full funding of the continued development and procurement of a competitive propulsion system for the F-35 Lightning II.

`(c) Requirement to Obligate and Expend Funds- Of the amounts authorized to be appropriated for fiscal year 2010 or any year thereafter, for research, development, test, and evaluation and procurement for the F-35 Lightning II Program, the Secretary of Defense shall ensure the obligation and expenditure in each such fiscal year of sufficient annual amounts for the continued development and procurement of two options for the propulsion system for the F-35 Lightning II in order to ensure the development and competitive production for the propulsion system for the F-35 Lightning II.'.

(b) Clerical Amendment- The table of sections at the beginning of such chapter is amended by at the end the following new item:

`235. Budget for competitive propulsion system for F-35 Lightning II.'.

(c) Conforming Repeal- The National Defense Authorization Act for Fiscal Year 2008 (P.L. 110-181) is amended by striking section 213.

Section 133 states:

SEC. 133. REPORT ON 4.5 GENERATION FIGHTER PROCUREMENT.

(a) In General- Not later than 90 days after the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on 4.5 generation fighter aircraft procurement. The report shall include the following:

(1) The number of 4.5 generation fighter aircraft for procurement for fiscal years 2011 through 2025 necessary to fulfill the requirement of the Air Force to maintain not less than 2,200 tactical fighter aircraft.

(2) The estimated procurement costs for those aircraft if procured through single year procurement contracts.

(3) The estimated procurement costs for those aircraft if procured through multiyear procurement contracts.

(4) The estimated savings that could be derived from the procurement of those aircraft through a multiyear procurement contract, and whether the Secretary determines the amount of those savings to be substantial.

(5) A discussion comparing the costs and benefits of obtaining those aircraft through annual procurement contracts with the costs and benefits of obtaining those aircraft through a multiyear procurement contract.

(6) A discussion regarding the availability and feasibility of F-35s in fiscal years 2015 through fiscal year 2025 to proportionally and concurrently recapitalize the Air National Guard.

(7) The recommendations of the Secretary regarding whether Congress should authorize a multiyear procurement contract for 4.5 generation fighter aircraft.

(b) Certifications- If the Secretary recommends under subsection (a)(7) that Congress authorize a multiyear procurement contract for 4.5 generation fighter aircraft, the Secretary shall submit to Congress the certifications required by section 2306b of title 10, United States Code, at the same time that the budget is submitted under section 1105(a) of title 31, United States Code, for fiscal year 2011.

(c) 4.5 Generation Fighter Aircraft Defined- In this section, the term `4.5 generation fighter aircraft' means current fighter aircraft, including the F-15, F-16, and F-18, that—

(1) have advanced capabilities, including—

(A) AESA radar;

(B) high capacity data-link; and

(C) enhanced avionics; and

(2) have the ability to deploy current and reasonably foreseeable advanced armaments.

Report Language

Regarding Air Force research and development funding for the F-35 program, the committee's report states:

> The budget request contained $1.9 billion in PE 64800F, and $1.7 billion in PE 64800N, for development of the F–35, but contained no funds for development of a competitive F–35 propulsion system. The committee notes that the aggregate amount requested for F–35 development is $1.4 billion higher than projected last year, and that $476.0 million of that amount conforms to increases recommended by a recent joint estimating team, and understands this amount will be used primarily for management reserve. The budget request also contained $2.0 billion for procurement of 10 F–35As and $300.6 million for F–35 advance procurement in Aircraft Procurement, Air Force, but contained no funds for either procurement of competitive F–35 propulsion systems or for advance procurement of competitive F–35 propulsion system long-lead components. Additionally, the budget request contained $4.0 billion for the procurement of 16 F–35Bs and four F–35Cs and $481.0 million for F–35 advance procurement in Aircraft Procurement, Navy, but contained funds for neither procurement of competitive propulsion systems nor advance procurement of competitive F–35 competitive F–35 propulsion systems long-lead components. The Aircraft Procurement, Navy budget request also contained $1.3 billion for spares and repair parts.
>
> The competitive F–35 propulsion system program is developing the F136 engine, which would provide a competitive alternative to the currently-planned F135 engine. For the past three years, in the committee report (H.Rept. 109-452) accompanying the John Warner National Defense Authorization Act for Fiscal Year 2007, in the committee report (H.Rept. 110-146) accompanying the National Defense Authorization Act for Fiscal Year 2008, and in the committee report (H.Rept. 110-652) accompanying the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, the committee recommended increases for

the F–35 competitive propulsion system, and notes that in all cases, the other three congressional defense committees also recommended increases for this purpose. Despite section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181), which requires the Secretary of Defense to obligate and expend sufficient annual amounts for the continued development and procurement of a competitive propulsion system for the F–35, the committee is disappointed that the Department of Defense (DOD) has, for the third consecutive year, chosen not to comply with both the spirit and intent of this provision by opting not to include funds for this purpose in the budget request.

The committee notes that the F135 engine development program has experienced cost growth since the engineering and manufacturing development (EMD) program began in fiscal year 2002. At the beginning of EMD in fiscal year 2002, the F135 engine development program was expected to cost $4.828 billion in then-year dollars. The F–35 program manager reports that as of the end of 2008, development costs have grown to $6.7 billion in then-year dollars, an increase of $1.872 billion, or 38 percent. Additionally, the committee notes that the F–35 program manager has reported an increase of approximately 38 to 43 percent in F135 engine procurement cost estimates between December 2005 and December 2008, in the annual selected acquisition reports for the F–35C and F–35A variants. Between December 2005 and December 2008, engine procurement cost estimates for the F–35B have grown approximately 47 percent, but the F–35B engine procurement cost growth is attributable to both the F135 engine and the F–35B's lift fan. Conversely, the F136 engine program has not experienced any cost growth since its inception. The F136 pre-EMD contract, which began in 2002 and was completed in 2004, was for $411.0 million and did not experience cost growth. The F136 EMD contract was awarded in 2005, and the cost estimate, at $2.486 billion, has been stable since contract award. Given the F135 development and procurement cost increases, the committee is perplexed by the Department's decisions over the past three years to not include an F–35 competitive propulsion system program in its budget requests. Based on the F135 cost growth, F135 test failures noted in the committee report (H.Rept. 110-652) accompanying the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, and resultant schedule delays due to F135 engine test failures, the committee remains steadfast in its belief that the non-financial factors of a two-engine competitive program such as better engine performance, improved contractor responsiveness, a more robust industrial base, increased engine reliability and improved operational readiness, strongly favor continuing the F–35 competitive propulsion system program.

The committee also notes that the Office of the Secretary of Defense's Director of Portfolio Acquisition testified before the Air and Land Forces Subcommittee on May 20, 2009, and stated that the Department planned a 75 percent higher year-over-year production rate for the F–35 program for fiscal year 2010 and that this rate, ''seems to be an achievable rate.'' The committee further notes that the production rate for fiscal year 2009 is 17 aircraft, of which 14 are for the Department of Defense and 3 are international aircraft. A 75 percent higher production rate for fiscal year 2010 would total 30 aircraft, and the committee notes that 2 international aircraft are planned, leaving 28 DOD aircraft in fiscal year 2010 necessary to achieve the 75 percent year-over-year production rate, two less than the 30 F–35s contained in the Department of the Navy and Department of the Air Force budget requests. Therefore, the committee recommends a reduction of one F–35B in Aircraft Procurement, Navy and one F–35A in Aircraft Procurement, Air Force, and report.

The committee understands that $320.0 million of the $476 million recommended by the recent joint estimating team would meet requirements for sufficient management reserve, and therefore recommends an aggregate reduction of $156.0 million in PEs 64800N and 64800F as noted in the tables elsewhere in this report.

> For continued development of the competitive F–35 propulsion system program, the committee recommends a total increase of $463.0 million in PEs 64800F and 64800N as noted in the tables elsewhere in this report. The committee also recommends an aggregate increase of $140.0 million as noted in the tables elsewhere in this report in Aircraft Procurement, Navy and Aircraft Procurement, Air Force for the procurement of four F136 engines, F136 spare parts, and advance procurement of F136 long-lead components to continue F136 procurement in fiscal year 2011. (Pages 201-203)

In the section on the operation and maintenance account, the report states:

> The committee is concerned that the lessons learned regarding the prevention and management of corrosion in the F–22 Raptor aircraft have not been fully applied to development and acquisition of the F–35 Joint Strike Fighter aircraft. The committee's desire to have corrosion prevention and management addressed early in weapons system development and acquisition prompted inclusion of a provision in the Weapons Systems Acquisition Reform Act of 2009 (Public Law 111–23) requiring the development of systems engineering master plans for major defense acquisition programs that include considerations of lifecycle management and sustainability.
>
> Therefore, the committee directs the Director of Corrosion Policy and Oversight (as designated by section 2228 of title 10, United States Code) to evaluate the F–35 Joint Strike Fighter program. The evaluation should include, but not be limited to, information obtained from floor inspections and examination of program documentation and should involve any and all manufacturing and engineering processes. The Director of Corrosion Policy and Oversight is directed to consult with the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics to determine the appropriate level of access necessary to conduct an effective and comprehensive evaluation of the F–35. The committee directs that the findings of the evaluation be reported to the congressional defense committees within 180 days after the date of enactment of this Act. The evaluation report should also include implications for existing and future weapons systems based on the findings of the F–35 evaluation. The committee directs the Comptroller General of the United States to provide an assessment to the congressional defense committees of the completeness of the evaluation within 60 days of the evaluation's delivery to the congressional defense committees. (Pages 289-290)

The report discusses the project Navy-Marine Corps strike fighter shortfall on pages 61-62. The report discusses the projected Air Force fighter shortfall, and requires a report on the topic, on page 101. The report summarizes Sections 133, 214, 218, 232, and 242 on pages 125, 240, 241, 243-244, and 244-245, respectively.

Statement of Administration Policy

A June 24, 2009, statement of administration policy on H.R. 2647 states the following regarding the F-35 program:

> *F-35 Joint Strike Fighter Program*: The Administration strongly objects to the addition of $603 million for development and procurement of the alternative engine program, and the requirement for the Department to fund the alternative engine program in future budget requests to the President. These changes will delay the fielding of the Joint Strike Fighter (JSF) capability and capacity, adversely impacting the Department's overall strike fighter inventory. In addition, the Administration objects to provisions of the bill that mandate an alternative engine program for the JSF. The current engine is performing well with more than 11,000 test hours. Expenditures on a second engine are unnecessary and impede the

> progress of the overall JSF program. Alleged risks of a fleet-wide grounding due to a single engine are exaggerated. The Air Force currently has several fleets that operate on a single-engine source. The Administration also objects to the limit on the obligation of overall JSF development funding to 75% of the amount authorized until Department of Defense (DOD) has obligated all funds provided in FY 2010 for the alternative engine program. *If the final bill presented to the President would seriously disrupt the F-35 program, the President's senior advisors would recommend a veto.*[143]

Senate (Committee Markup)

Quantities and Funding

In S. 1390 as reported by the Senate Armed Services Committee, Division D presents committee's detailed the line-tem funding recommendations. Division D does the following:

- approves the administration's request to procure 20 F-35Bs and Cs for the Marine Corps and Navy, and approves the administration's request for procurement and advance procurement funding for these aircraft (page 613 of the printed bill);
- approves the administration's request to procure 10 F-35As for the Air Force, and approves the administration's request for procurement and advance procurement funding for these aircraft (page 629);
- recommends a net increase of $141.45 million in Navy research and development funding for the F-35 program, consisting of an increase of $219.45 million for the F136 alternate engine and a reduction of $78 million for excess management reserves (page 678); and
- recommends a net increase of $141.45 million in Air Force research and development funding for the F-35 program, consisting of an increase of $219.45 million for the F136 alternate engine and a reduction of $78 million for excess management reserves (page 687).

Legislative Provisions

S. 1390 contains a provision (Section 211) relating directly to the F-35 program. The text of the section, which concerns the F-35 alternate engine, states:

> SEC. 211. CONTINUED DEVELOPMENT OF COMPETITIVE PROPULSION SYSTEM FOR THE JOINT STRIKE FIGHTER PROGRAM.
>
> Of the amounts authorized to be appropriated or otherwise made available for fiscal year 2010 for research, development, test, and evaluation for the F-35 Lightning II aircraft program, not more than 90 percent may be obligated until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for fiscal year 2010 for the continued development of a competitive propulsion system for the F-35 Lightning II aircraft to ensure that system development and demonstration continues under the program during fiscal year 2010.

[143] Executive Office of the President, Office of Management and Budget, *Statement of Administration Policy, H.R. 2647 - National Defense Authorization Act for Fiscal Year 2010*, June 24, 2009, pp. 1-2. Emphasis as in the original.

Report Language

Regarding Section 211, the committee's report on S. 1390 (S.Rept. 111-35 of July 2, 2009) states:

> The committee recommends a provision that would require the Department to obligate sufficient funds for fiscal year 2010 for the continued development and procurement of the F136 competitive propulsion system for the F–35 Lightning II to ensure that the Department continues the system development and demonstration (SDD) program during fiscal year 2010. The committee understands that current plans for the F136 Joint Strike Fighter (JSF) propulsion system would complete the development in sufficient time to conduct a first competitive contract award in fiscal year 2012, concurrent with the award for the sixth lot of low-rate initial production aircraft.
>
> The budget request included $1,741.3 million in PE 64800N, and $1,858.1 million in PE 64800F for continued development of the JSF program, but included no funds for continuing the SDD phase of the F136 program.
>
> The committee continues to believe that, in light of studies performed by the Department of Defense, the Institute for Defense Analyses, and the Government Accountability Office, it is in the best interests of the Nation to continue the development of the F136. Though the results of these studies were, in the aggregate, inconclusive on whether there would be a financial benefit to the Department in continuing to develop a competitive propulsion system for the JSF program, the committee notes that all studies identified significant non-financial factors of a two-engine competitive program. These included better engine performance; improved contractor responsiveness; a more robust industrial base; increased engine reliability; and improved operational readiness. The committee believes that the benefits, which could be derived from the non-financial factors, favor continuing the JSF competitive propulsion system program.
>
> Therefore, the committee recommends an increase of $438.9 million for continuing F136 SDD, with half that amount added to PE 64800N and the other half added to PE 64800F. (Page 35)

The committee's report states that the recommendation to include additional Navy and Air Force research and development funding for the F-35 alternate engine was approved in full-committee markup by a vote of 12–10, with the votes as follows: "In Favor: Senators Levin, Kennedy, Byrd, Nelson of Florida, Bayh, Webb, McCaskill, Hagan, Begich, Thune, Wicker, and Vitter. Opposed: Senators Lieberman, Reed, Akaka, Nelson of Nebraska, Udall of Colorado, Inhofe, Sessions, Chambliss, Martinez, and Collins." (Page 276)

Regarding funding for management reserves within Air Force and Navy research and development funding for the F-35 program, the committee's report states:

> The budget request included $1,741.3 million [Navy research and development funding] in PE 64800N, and $1,858.1 million [Air Force research and development funding] in PE 64800F for continued development of the Joint Strike Fighter (JSF) program, including $476.0 million for management reserves to cover unforeseen problems that may arise during the system development and demonstration (SDD) phase of the program.
>
> The Department conducted a review of JSF program costs and schedules last year. The group conducting the review, called the Joint Estimating Team (JET), recommended, among other things, that the management reserves available to the program executive officer (PEO) be increased throughout the remainder of SDD program. As a result of the JET

> recommendations, the Department increased management reserves to the level requested in the budget.
>
> The Department has informed the committee that the PEO now believes that he can fully execute the fiscal year 2010 SDD program with only $320.0 million, or $156.0 million less than was included in the request.
>
> Therefore, the committee recommends a decrease of $78.0 million in PE 64800N and a decrease of $78.0 million in PE 64800F to eliminate these excess management reserves. (Page 82)

The report discusses the project Navy-Marine Corps strike fighter shortfall on pages 20-22.

Statement of Administration Policy

A July 15, 2009, statement of administration policy on S. 1390 states the following regarding the F-35 program:

> F-35 Joint Strike Fighter (JSF) Program: The Administration strongly objects to the addition of $438.9 million for development of the alternative engine program. The Administration also objects to provisions of the bill that mandate an alternative engine program for the JSF. The current engine is performing well with more than 11,000 test hours. In addition, the risks associated with a single engine provider are manageable as evidenced by the performance of the F-22 and F/A-18E/F, Air Force and Navy programs supplied by a single engine provider. Expenditures on a second engine are unnecessary and impede the progress of the overall JSF program. The Air Force currently has several fleets that operate on a single-engine source. The Administration also objects to the limit on the obligation of overall JSF development funding to 90 percent of the amount authorized until the Secretary of Defense submits a written certification that sufficient funds have been obligated in FY 2010 for the alternative engine program. If the final bill presented to the President would seriously disrupt the F-35 program, the President's senior advisors would recommend a veto.[144]

Senate (Floor Consideration)

Summary

On July 23, 2009, as part of its consideration of S. 1390, the Senate rejected by a vote of 38 to 59 (Record Vote 240) an amendment (S.Amdt. 1767) that would have modified Section 211 as reported by the Senate Armed Services Committee so as to preserve the additional research and development funding for the alternate engine program, but make that funding available through an offset taken from a place in the defense budget other than what was recommended in the Senate Armed Services Committee markup.

Following its rejection of S.Amdt. 1767, the Senate adopted by voice vote another amendment (S.Amdt. 1627) that rewrites Section 211 so as to remove the research and development funding that was added in committee markup for an alternate engine program. The amendment also prohibits the obligation or expenditure of FY2010 funding on an alternate program until the

[144] Executive Office of the President, Office of Management and Budget, *Statement of Administration Policy, S. 1390 – National Defense Authorization Act for Fiscal Year 2010*, July 15, 2009, pp. 1-2. Emphasis as in the original.

Secretary of Defense makes certain certifications regarding its cost effectiveness. As amended by S.Amdt. 1627, S. 1390 is now generally consistent with the Administration's proposal to terminate the alternate engine program.

S.Amdt. 1767 (Not Agreed To)

S.Amdt. 1767 would have:

- preserved the language from Sec. 211 as reported by the Senate Armed Services Committee that would prohibit DOD from obligating more than 90% of FY2010 F-35 research and development funds until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for FY2010 for the continued development of a competitive propulsion system for the F-35 to ensure that system development and demonstration continues under the program during FY2010;
- preserved the additional research and development funding for the alternate engine program that was added in the Senate Armed Services Committee markup;
- restored reductions to the UH-1Y/AH-1Z helicopter program and to F-35 program management reserves that were made so as to make available the funding that was added for the alternate engine program; and
- instead reduced funding for the HC/MC-130 aircraft program—a program that received $504 million in procurement funding in the FY2009 supplemental appropriations act (H.R. 2346/P.L. 111-32 of June 24, 2009).[145]

The text of S.Amdt. 1767 is as follows:

> SEC. 211. CONTINUED DEVELOPMENT OF COMPETITIVE PROPULSION SYSTEM FOR THE JOINT STRIKE FIGHTER PROGRAM.
>
> (a) In General.—Of the amounts authorized to be appropriated or otherwise made available for fiscal year 2010 for research, development, test, and evaluation for the F-35 Lightning II aircraft program, not more than 90 percent may be obligated until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for fiscal year 2010 for the continued development of a competitive propulsion system for the F-35 Lightning II aircraft to ensure that system development and demonstration continues under the program during fiscal year 2010.
>
> (b) Additional Amount for UH-1Y/AH-1Z Rotary Wing Aircraft.—The amount authorized to be appropriated by section 102(a)(1) for aircraft procurement for the Navy is hereby increased by $282,900,000, with the amount of the increase to be allocated to amounts available for the procurement of UH-1Y/AH-1Z rotary wing aircraft.
>
> (c) Restoration of Management Reserves for F-35 Joint Strike Fighter Program.—
>
> (1) NAVY JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(2) for research, development, test, and evaluation for the Navy is hereby

[145] See page 93 of the conference report on H.R. 2346 (H.Rept. 111-151 of June 12, 2009).

> increased by $78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800N) for management reserves.
>
> (2) AIR FORCE JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(3) for research, development, test, and evaluation for the Air Force is hereby increased by $78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800F) for management reserves.
>
> (d) Offset.—The amount authorized to be appropriated by section 103(1) for aircraft procurement for the Air Force is hereby decreased by $438,900,000, with the amount of the decrease to be derived from amounts available for airlift aircraft for the HC/MC-130 recapitalization program.

S.Amdt. 1627 (Agreed To)

S.Amdt. 1627 would:

- eliminate the language from Sec. 211 as reported by the Senate Armed Services Committee that would prohibit DOD from obligating more than 90% of FY2010 F-35 research and development funds until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for FY2010 for the continued development of a competitive propulsion system for the F-35 to ensure that system development and demonstration continues under the program during FY2010;
- replace the eliminated language with new language that prohibits the obligation or expenditure of FY2010 funding on an alternate engine program until the Secretary of Defense makes certain certifications regarding cost effectiveness of such a program;
- eliminate the additional research and development funding for the alternate engine program that was added in the Senate Armed Services Committee markup;
- restore reductions to the UH-1Y/AH-1Z helicopter program and to F-35 program management reserves that were made so as to make available the funding that was added for the alternate engine program.

The text of S.Amdt. 1627 is as follows:

> SEC. 211. LIMITATION ON USE OF FUNDS FOR AN ALTERNATIVE PROPULSION SYSTEM FOR THE F-35 JOINT STRIKE FIGHTER PROGRAM; INCREASE IN FUNDING FOR PROCUREMENT OF UH-1Y/AH-1Z ROTARY WING AIRCRAFT AND FOR MANAGEMENT RESERVES FOR THE F-35 JOINT STRIKE FIGHTER PROGRAM.
>
> (a) Limitation on Use of Funds for an Alternative Propulsion System for the F-35 Joint Strike Fighter Program.—None of the funds authorized to be appropriated or otherwise made available by this Act may be obligated or expended for the development or procurement of an alternate propulsion system for the F-35 Joint Strike Fighter program until the Secretary of Defense submits to the congressional defense committees a certification in writing that the development and procurement of the alternate propulsion system—
>
> (1) will—

(A) reduce the total life-cycle costs of the F-35 Joint Strike Fighter program; and

(B) improve the operational readiness of the fleet of F-35 Joint Strike Fighter aircraft; and

(2) will not—

(A) disrupt the F-35 Joint Strike Fighter program during the research, development, and procurement phases of the program; or

(B) result in the procurement of fewer F-35 Joint Strike Fighter aircraft during the life cycle of the program.

(b) Additional Amount for UH-1Y/AH-1Z Rotary Wing Aircraft.—The amount authorized to be appropriated by section 102(a)(1) for aircraft procurement for the Navy is increased by $282,900,000, with the amount of the increase to be allocated to amounts available for the procurement of UH-1Y/AH-1Z rotary wing aircraft.

(c) Restoration of Management Reserves for F-35 Joint Strike Fighter Program.—

(1) NAVY JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(2) for research, development, test, and evaluation for the Navy is hereby increased by $78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800N) for management reserves.

(2) AIR FORCE JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(3) for research, development, test, and evaluation for the Air Force is hereby increased by $78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800F) for management reserves.

(d) Offsets.—

(1) NAVY JOINT STRIKE FIGHTER F136 DEVELOPMENT.—The amount authorized to be appropriated by section 201(a)(2) for research, development, test, and evaluation for the Navy is hereby decreased by $219,450,000, with the amount of the decrease to be derived from amounts available for the Joint Strike Fighter (PE # 0604800N) for F136 development.

(2) AIR FORCE JOINT STRIKE FIGHTER F136 DEVELOPMENT.—The amount authorized to be appropriated by section 201(a)(3) for research, development, test, and evaluation for the Air Force is hereby decreased by $219,450,000, with the amount of the decrease to be derived from amounts available for the Joint Strike Fighter (PE # 0604800F) for F136 development.

Conference

Quantities and Funding

The conference report (H.Rept. 111-288 of October 7, 2009) on the FY2010 defense authorization bill (H.R. 2647) authorizes funding for procuring a total of 30 F-35s in FY2010, as requested (pages 933 and 948). The report authorizes $215 million in Air Force research and development funding (page 1017) and $215 million in Navy research and development funding (page 1005) for continued development of the F136 alternate engine, and $130 million in Air Force advance procurement funding to begin procurement of F136 engines (page 948).

Legislative Provisions

Section 131 of the bill requires a report on the procurement of "4.5"-generation fighters that is to include, among other things, "a discussion regarding the availability and feasibility of procuring F-35 aircraft to proportionally and concurrently recapitalize the Air National Guard during fiscal years 2015 through fiscal year 2025." Section 217 requires future DOD budgets to provide separate line items for the F-35B and F-35C within the Navy aircraft procurement account and the Navy research and development account. Section 244 requires, for the period 2010-2015, an annual GAO report on the status of the F-35 program.

Section 131 states:

> SEC. 131. REPORT ON THE PROCUREMENT OF 4.5 GENERATION FIGHTER AIRCRAFT.
>
> (a) IN GENERAL.—Not later than 90 days after the date of the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on the procurement of 4.5 generation fighter aircraft. The report shall include the following:
>
> (1) The number of 4.5 generation fighter aircraft needed to be procured during fiscal years 2011 through 2025 to fulfill the requirement of the Air Force to maintain not less than 2,200 tactical fighter aircraft.
>
> (2) The estimated procurement costs for those aircraft if procured through annual procurement contracts.
>
> (3) The estimated procurement costs for those aircraft if procured through multiyear procurement contracts.
>
> (4) The estimated savings that could be derived from the procurement of those aircraft through a multiyear procurement contract, and whether the Secretary determines the amount of those savings to be substantial.
>
> (5) A discussion comparing the costs and benefits of obtaining those aircraft through annual procurement contracts with the costs and benefits of obtaining those aircraft through a multiyear procurement contract.
>
> (6) A discussion regarding the availability and feasibility of procuring F–35 aircraft to proportionally and concurrently recapitalize the Air National Guard during fiscal years 2015 through fiscal year 2025.
>
> (b) 4.5 GENERATION FIGHTER AIRCRAFT DEFINED.—In this section, the term ''4.5 generation fighter aircraft'' means current fighter aircraft, including the F–15, F–16, and F–18, that—
>
> (1) have advanced capabilities, including—
>
> (A) AESA radar;
>
> (B) high capacity data-link; and
>
> (C) enhanced avionics; and

(2) have the ability to deploy current and reasonably foreseeable advanced armaments.

Section 217 states:

SEC. 217. SEPARATE PROCUREMENT AND RESEARCH, DEVELOPMENT, TEST, AND EVALUATION LINE ITEMS AND PROGRAM ELEMENTS FOR THE F–35B AND F–35C JOINT STRIKE FIGHTER AIRCRAFT.

In the budget materials submitted to the President by the Secretary of Defense in connection with the submission to Congress, pursuant to section 1105 of title 31, United States Code, of the budget for fiscal year 2011, and each subsequent fiscal year, the Secretary shall ensure that within the Navy research, development, test, and evaluation account and the Navy aircraft procurement account, a separate, dedicated line item and program element is assigned to each of the F–35B aircraft and the F–35C aircraft, to the extent that such accounts include funding for each such aircraft.

Section 244 states:

SEC. 244. ANNUAL COMPTROLLER GENERAL REPORT ON THE F–35 LIGHTNING II AIRCRAFT ACQUISITION PROGRAM.

(a) ANNUAL GAO REVIEW.—The Comptroller General shall conduct an annual review of the F–35 Lightning II aircraft acquisition program and shall, not later than March 15 of each of 2010 through 2015, submit to the congressional defense committees a report on the results of the most recent review.

(b) MATTERS TO BE INCLUDED.—Each report on the F–35 program under subsection (a) shall include each of the following:

(1) The extent to which the acquisition program is meeting development and procurement cost, schedule, and performance goals.

(2) The progress and results of developmental and operational testing and plans for correcting deficiencies in aircraft performance, operational effectiveness, and suitability.

(3) Aircraft procurement plans, production results, and efforts to improve manufacturing efficiency and supplier performance.

Report Language

F–35 and alternate propulsion system program

The Senate amendment contained a provision (sec. 211) that would: (1) increase in funding for procurement of UH–1Y/AH–1Z rotary wing aircraft and for management reserves for the F–35 Joint Strike Fighter program; and (2) prohibit the obligation of funds authorized to be appropriated for development or procurement of an alternate propulsion system for the F–35 until the Secretary of Defense certifies in writing to the congressional defense committees that development and procurement of the alternate propulsion system would: (a) reduce life cycle costs of the F–35; (b) improve operational readiness of the fleet of F–35 aircraft; (c) will not disrupt the F–35 research, development, test, and evaluation (RDT&E) and procurement phases of the program; and (d) will not result in the procurement of fewer F–35 aircraft during the life cycle of the program.

The House bill contained a provision (sec. 218) that would limit obligations for the F–35 RDT&E program to 75 percent until 15 days after the later of the dates on which: (1) the Under Secretary of Defense for Acquisition, Technology, and Logistics certifies in writing to the congressional defense committees that all fiscal year 2010 funds for the F–35 competitive propulsion system have been obligated; (2) the Secretary of Defense submits the report on F/A–18 multiyear procurement costs required by section 123 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 (Public Law 110–417); and (3) the Department submits the 30-year aircraft procurement plan required by section 231a of title 10, United States Code.

The House bill also contained a provision (sec. 242) that would require the Secretary of Defense to include in annual budget requests submitted to the President, beginning in 2011, such amounts as are necessary for the full funding of continued development and procurement of a competitive propulsion system for the F–35.

Both the House and Senate recede from their respective provisions.

The conferees agree to authorize the budget request for 30 F–35 aircraft in Aircraft Procurement, Navy, and Aircraft Procurement, Air Force. The conferees also agree to authorize an increase of a total of $430.0 million in RDT&E, Navy, and RDT&E, Air Force for continued F136 engine development; and $130.0 million in Aircraft Procurement, Air Force, for F136 engine procurement. The conferees expect that the Secretary of Defense will comply with the direction in section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181), and ensure that sufficient annual amounts are obligated and expended, in each fiscal year, for the continued development and procurement of two options for the F–35 propulsion system in order to ensure the development and competitive production of the F–35 propulsion system. (Pages 706-707)

FY2010 DOD Appropriations Bill (H.R. 3326)

House

Quantities and Funding

The House Appropriations Committee, in its report (H.Rept. 111-230 of July 24, 2009) on H.R. 3326, recommends the following:

- procuring 18 F-35Bs and Cs for the Marine Corps and Navy—a reduction of two aircraft from the requested figure of 20 (page 148);
- procuring 10 F-35As for the Air Force—the requested figure (page 184);
- a reduction of $420.6 million in Navy aircraft procurement funding for the procurement of F-35Bs and Cs for the Marine Corps and Navy, consisting of a reduction of $300 million for "Reduction of two aircraft – no FY 2009 advance procurement," and a reduction of $120.6 million for non-recurring equipment execution" (page 151, line 6);
- a net increase of $18.6 million in Air Force procurement funding for the F-35 program, consisting of a reduction of $111.4 million for "Reduction to non-recurring engineering" and an increase of $130 million for the alternate engine (page 187, line 1);

- a reduction of $22 million in Air Force advance procurement funding for the F-35 program for "Reduction of 2 aircraft previously funded in fiscal year 2009" (page 187, line 2);
- an increase of $215 million in Navy research and development funding for the F-35 alternate engine (page 258, line 127); and
- an increase of $215 million in Air Force research and development funding for the F-35 alternate engine (page 273, line 84).

As discussed below in the section on report language, the recommended two-aircraft reduction in the number of F-35Bs and Cs to be procured is for F-35Bs, making for a recommended procurement of 14 F-35Bs and 4 F-35Cs.

Report Language

Regarding procurement funding for the F-35 program, the committee's report states:

> F–35 LIGHTNING II JOINT STRIKE FIGHTER
>
> Last year, the Congress appropriated advance procurement funding for 14 fiscal year 2010 F–35 Short Take-Off and Vertical Landing (STOVL) aircraft [i.e., F-35Bs]. However, this year's request contains full funding for the procurement of 16 STOVL aircraft. Without the proper advance procurement funding, two of the fiscal year 2010 aircraft will not execute until fiscal year 2011. Since these aircraft will execute as fiscal year 2011 aircraft, they should be funded in fiscal year 2011. Therefore, the recommendation removes $300,000,000, the cost of two STOVL aircraft, from the program. This adjustment is consistent with the Navy's own adjustments to other aircraft procurement programs. (Pages 153-154)

The report also states:

> JOINT STRIKE FIGHTER NON-RECURRING EQUIPMENT
>
> The Joint Strike Fighter program budgets for and procures equipment and tooling to outfit the manufacturing facility with sufficient capacity to produce aircraft in larger quantities as the production program ramps up. Since the program began production in fiscal year 2007, the Congress has appropriated over $900,000,000 for this effort. However, in actuality, the program has executed just over $700,000,000, largely because the production ramp up has been lower than originally predicted. Therefore, the recommendation reduces the request for non-recurring equipment by $232,000,000 to fund this activity at a level consistent with historical execution. (Page 119)

Regarding administration proposals to terminate programs, including the F-35 alternate engine program, the report states:

> The Committee also seeks to reverse a recent and increasing trend to curtail the development of systems before such efforts realize any benefit to the taxpayer. The Committee strongly supports realistic budgeting that matches available funding to overall programs. Indeed, many of the program terminations proposed in the fiscal year 2010 budget request are supported in this bill. Nevertheless, the Committee is concerned that the proposal to terminate some programs is premature, and believes that continuing certain efforts may yield significant payback. The Committee believes that this is clearly the case for the presidential helicopter, wherein five aircraft have been purchased that could be pressed into service. Similarly, in the Committee's view, there is potential for significant payback associated with

> the Joint Strike Fighter alternative engine and certain missile defense activities provided in this recommendation. (Page 4)

The report also states:

> JOINT STRIKE FIGHTER ALTERNATE ENGINE
>
> The F–35 Lightning II Joint Strike Fighter program truly represents the Nation's future with respect to tactical aviation. The Navy, Marine Corps and Air Force plan to procure over 2,500 of these fifth generation stealthy aircraft and will fly them well into the future. The Department's original plan for the F–35 propulsion engine was to have two engine variants. Cost growth in other areas of the development program resulted in the Department abandoning the alternate engine program. Currently, all three variants of the F–35 aircraft will be powered by the same propulsion engine. Although this will make the logistics for the aircraft less complex, this practice presents problems. The Committee is extremely concerned that in the near future when the F–35 will comprise the majority of the Nation's tactical aircraft inventory any technical problems with the engine could theoretically ground the entire fleet of aircraft. If this situation were to arise in a time of crisis, the Commander-in-Chief's flexibility would be severely limited.
>
> Another area of concern for the Committee is the lack of competition for the Joint Strike Fighter engine program. With over 2,500 aircraft envisioned for this program, the potential for cost savings through an engine competition is enormous. The Committee is aware that the Department conducted a business case analysis that compared the cost of the program of record (sole source engine provider) to a program using a dual source strategy for the engine program. The business case concluded that the costs of the two programs were essentially the same. Since the Congress has put several hundred million dollars into the development of an alternate engine program since this business case was published, the Committee is puzzled by the Department's decision to not fund the alternate engine. With the majority of the upfront development cost having been sunk into the program, it seems clear that from this point forward the dual source strategy is the most cost effective method to acquire the propulsion engine for the Joint Strike Fighter. Therefore, the recommendation provides an additional $430,000,000 for the continued development of the alternate engine and $130,000,000 for alternate engine production costs for a total of $560,000,000 above the request for the alternate engine program. Further, since a dual source engine strategy is the most cost effective method for acquiring engines from this point forward, the Secretary of Defense is directed to include funding for the alternate engine program in future budget requests. (Pages 215-216)

Statement of Administration Policy

A July 28, 2009, statement of administration policy on H.R. 3326 as reported in the House states the following regarding the F-35 program:

> *Joint Strike Fighter (F-35) Alternate Engine*. The Administration strongly objects to the addition of $130 million to produce, and $430 million to continue the development of, the Joint Strike Fighter (JSF) alternate engine, which was proposed for termination by the President. Expenditures on an alternate engine for the JSF are unnecessary and divert resources from the overall JSF program. The current engine is performing well, and the risks associated with a single engine provider are manageable. If the final bill presented to the

President would seriously disrupt the F-35 program, the President's senior advisors would recommend that he veto the bill.[146]

Senate

Quantities and Funding

The Senate Appropriations Committee, in its report (S.Rept. 111-74 of September 10, 2009) on H.R. 3326, recommends the following:

- procuring 20 F-35Bs and Cs for the Marine Corps and Navy—the requested figure (page 101);
- procuring 10 F-35As for the Air Force—the requested figure (page 129);
- a reduction of $22 million in Air Force advance procurement funding for the procurement of F-35As in a future fiscal year for "Reduction of two aircraft" (page 133, line 2);
- a reduction of $78 million in Navy research and development funding for the F-35 program for "Excess to need" (page 184, line 127);
- a reduction of $78 million in Air Force research and development funding for the F-35 program for "Excess to need" (page 197, line 84); and
- an increase of $3 million in Air Force research and development funding for the Aerospace Propulsion and Power Technology program for "Silicon Carbide Power Modules for the F-35 Joint Strike Fighter" (page 196; line 22).

The committee's report recommends no funding for F-35 alternate engine development.

Report Language

The committee's report mentions the F-35 program on page 257 as part of a discussion of its recommendation for procurement of Navy F/A-18E/F strike fighters, stating: "The Committee is concerned about the shortfall in the Navy's strikefighter inventory created by the aging of the older F/A–18 models and the fact that the F–35 Joint Strike Fighter program will not start delivering carrier aircraft in significant numbers for several years."

[146] Executive Office of the President, Office of Management and Budget, *Statement of Administration Policy, H.R. 3326 – Department of Defense Appropriations Act, 2010*, July 28, 2009, p. 2. Emphasis as in the original.

Appendix A. Alternate Engine Program: Prior-Year Legislative Activity

This appendix presents details from the legislative history of the F-35 alternate engine program for the period FY1996-FY2009. The appendix focuses on presenting final bill language and committee and conference report language. It omits bill language in House- or Senate-reported versions of bills, as well as numerous instances in which committee or conference reports recommended additional funding for the F-35 alternate engine program but did not otherwise discuss the program in report language. The F-35 program was known in FY1996 and FY1997 as the Joint Advanced Strike Technology (JAST) program.

FY1996

Defense Authorization Act (S. 1124/P.L. 104-106 of February 10, 1996)

Section 213 of S. 1124/P.L. 104-106 authorized funds for the JAST program, required DOD to submit a report on the JAST program, and limited the obligation of JAST program funds until 30 days after the report is submitted. Subsection (b)(2) of Section 213 stated that $7 million of the research and development funding authorized in the act "shall be available to provide for competitive engine concepts" for the JAST program. Subsection (d) required a report on requirements for the JAST program and other combat aircraft, and on certain planning assumptions that affect those requirements.

The conference report (H.Rept. 104-450 of January 22, 1996) on S. 1124 discussed Section 213 on pages 705-707, stating in part:

> The Senate report (S.Rept. 104-112) questioned whether the program could fulfill the needs of the three services, and directed the Department to include two separate approaches in the JAST program to reduce program risk. The Senate amendment directed the Secretary of the Navy to:...
>
> (2) evaluate at least two propulsion concepts from competing engine companies as part of those demonstrations....
>
> The conferees share the concerns expressed in the Senate report (S.Rept. 104-112) regarding the lack of engine competition and the size of flying prototypes. The conferees direct the Under Secretary of Defense (Acquisition & Technology) (USD (A&T)) to ensure that: (1) the Department's JAST program plan provides for adequate engine competition in the program; and (2) the scale of the proposed demonstrator aircraft is consistent with both adequately demonstrating JAST concepts and lowering the risk of entering engineering and manufacturing development (EMD). The conferees direct the Secretary of Defense to include in the report required by section 213(d) the Department's plan for competitive engine programs and demonstrator aircraft.
>
> The conferees recommend authorization of funds reflecting these changes, and agree to a provision (sec. 213) that would:...
>
> (4) authorize $7.0 million for competitive engine concepts.

The Senate Armed Services Committee report (S.Rept. 104-112 of July 12, 1995) on S. 1026, an earlier version of the FY1996 defense authorization bill, discussed the JAST program on pages 95-97, stating in part:

> Further, the committee believes supporting competitive propulsion programs would help reduce risk and lead to higher confidence of achieving more affordable life cycle costs. The committee fears that the current JAST approach may lead to selecting one power plant manufacturer prematurely. Therefore, the committee directs the Secretary to evaluate at least two propulsion concepts from competing engine companies as part of the full scale, full thrust aircraft demonstrators. (Page 96)

DOD Appropriations Act (H.R. 2126/P.L. 104-61 of December 1, 1995)

The House Appropriations Committee report (H.Rept. 104-208 of July 27, 1995) on H.R. 2126 discussed the JAST program on page 150, stating in part:

> The history of recent fighter engine propulsion plants demonstrates that development of new engines is difficult. The Navy has generally been dissatisfied with the engine performance of early model F–14s, and it eventually upgraded later model F–14s with an Air Force engine. The Air Force in the late 1970s and early 1980s was dissatisfied with both the performance and cost of engines on early models of the F–15 and the F–16, and it spent over a billion dollars to bring a second engine manufacturer into a position where competition could be conducted between two companies for future Air Force fighter aircraft. The new engine for the F–22 has suffered technical problems and is undergoing a redesign.
>
> The Joint Advanced Strike Technology (JAST) program envisions building a common aircraft to satisfy the needs of the Air Force, Navy and Marine Corps for fighter aircraft in the next century. Yet, it has selected a single power plant design, a derivative of the F–22 engine which has yet to be proven. Given the engine performance difficulties experienced over the last two decades, this is unwise. To cede the manufacture of all jet engines for three services' future aircraft without any additional competition is not likely to be cost effective. For these reasons, the Committee believes it is imperative for the JAST program to actively pursue an engine design from a second manufacturer and has provided an additional $20,000,000 only for this purpose.

FY1997

Defense Authorization Act (H.R. 3230/P.L. 104-201 of September 23, 1996)

The Senate Armed Services Committee report (S.Rept. 104-267 of May 13, 1996) on S. 1745, the companion bill to H.R. 3230, discussed the JAST program on page 181, stating in part:

> The committee is persuaded that the benefits of engine competition will outweigh any near-term investment. Accordingly, the committee directs that remaining competition funds be rebaselined to guarantee integration into the preferred weapons system concept at the earliest practical point.

DOD Appropriation Act (H.R. 3610/P.L. 104-208 of September 30, 1996)

H.R. 3610/P.L. 104-208 was an omnibus appropriations act that included the DOD appropriations act. The House Appropriations Committee report (H.Rept. 104-617 of June 11, 1996) on H.R. 3610 discussed the JAST program on page 151, stating in part:

> The Committee recommends $602,100,000, an increase of $13,000,000 in the Navy account only to accelerate development of an alternate engine in order to have it available at the beginning of the engineering and manufacturing development phase of the program. This increase should be part of a program to develop a demonstrator engine and integrate it into the selected weapon systems contractor concepts.

FY1998

Defense Authorization Act (H.R. 1119/P.L. 105-85 of November 18, 1997)

Section 213 of H.R. 1119/P.L. 105-85 states in part:

> SEC. 213. JOINT STRIKE FIGHTER PROGRAM.
>
> (a) REPORT.—Not later than February 15, 1998, the Secretary of Defense shall submit to the congressional defense committees a report on the options for the sequence in which the variants of the joint strike fighter are to be produced and fielded.
>
> (b) CONTENT OF REPORT.—The report shall contain the following:...
>
> (4) A certification that the Joint Strike Fighter Program contains sufficient funding to carry out an alternate engine development program that includes flight qualification of an alternate engine in a joint strike fighter airframe....

The House Armed Services Committee report (H.Rept. 105-132 of June 16, 1997) on H.R. 1119 discussed the JSF program on pages 189-190, 212, and 243. The discussion on pages 189-190 states in part:

> The committee is also concerned that the 1997 FYDP does not reflect adequate funding within the JSF program to continue development of the alternative fighter engine (AFE) beyond the current demonstration/validation phase. The committee continues to believe that a fully developed and flight tested AFE is essential to reduce risk to the JSF program and to provide credible competition necessary for controlling program cost. Therefore, the committee directs the Secretary of Defense to provide a report to the Congressional defense committees no later than February 15, 1998, detailing the level of funding within the JSF program that is identified to fund full development and flight test of the AFE.

The Senate Armed Services Committee report (S.Rept. 105-29 of June 17, 1997) on S. 924, the companion bill to H.R. 1119, discussed the JSF program on pages 119-120, stating in part:

> The budget request included funds for the continuation of a program to establish an alternative engine for the joint strike fighter, but omitted funds for fiscal year 1998. The committee is persuaded that there is a need for an alternative engine for the JSF, but expects the Department to program sufficient funds in the future years for a robust, accelerated profile. Accordingly, the committee recommends an increase in the budget request of $28.0

> million to accelerate the alternative engine program, with the understanding that the Department will provide for the accelerated program in fiscal year 1999 and beyond.

FY1999

Defense Authorization Act (H.R. 3616/P.L. 105-261 of October 17, 1998)

The Senate Armed Services Committee report (S.Rept. 105-189 of May 11, 1998) on S. 2060, the companion bill to H.R. 3616, discussed the JSF program on pages 168-169, stating in part:

> Section 213 of the National Defense Authorization Act for Fiscal Year 1998 (Public Law 105–85) required a report on the order of fielding the variants of the JSF, and that specifically addressed the acceleration of the naval variant. The report included a certification that the JSF program contains sufficient funding to carry out an alternate engine program that includes flight qualification of an alternate engine in a JSF airframe.
>
> While not in total agreement with the report, the committee notes the timely submission and clear presentation of the Department of Defense priorities and plans. The certification of a funded program for an alternate engine is a positive commitment to cost-effective program management. However, the actual demonstration of the alternate engine in a JSF airframe has been continuously shifted to the ''out years,'' an action that threatens to invalidate the whole initiative. If the alternate engine is not completed for use for the most stressing of the JSF requirements (the short takeoff/vertical landing variant), then it may be too late to provide a major benefit to the program. Accordingly, the committee recommends an increase of $15.0 million to the budget request to accelerate the development of an alternative engine for the JSF.

FY2000

Defense Authorization Act (S. 1059/P.L. 106-65 of October 5, 1999)

The House Armed Services Committee report (H.Rept. 106-162 of May 24, 1999) on H.R. 1401, the companion bill to S. 1059, discussed the JSF program on pages 236-237, stating in part:

> The committee continues its strong support for the development of an alternate engine to ensure sustainment of critical industrial base capabilities, control of engine cost growth, and reduction of risk to the reliability and maintainability of the planned fleet of 3,000 JSF aircraft. The committee is concerned that while the Department now states a commitment to development of an alternative engine for JSF, the planned funding levels outlined to sup port that commitment do not enable cost-efficient and timely completion of the effort.
>
> Meanwhile, the Department is also conducting other jet engine development efforts in PE 27268F as part of the aircraft engine CIP. The committee notes that requested funding for this level of effort program has increased by $66.6 million, over 40 percent, from the level projected for fiscal year 2000 just last year. The justification for the requested increase is to reduce backlog of proposed engineering tasks for currently fielded engines. While supportive of the CIP, the committee does not consider the proposed increase to this program to be of higher priority than development of a new state-of-the-art alternative engine for JSF. The committee notes that full development of a flight qualified jet engine also provides opportunities to migrate proven new technologies to existing engines.

> Therefore, the committee recommends $130.2 million in PE 27268F, a decrease of $30.0 million, and $265.4 million in PE 63800F, an increase of $30.0 million, and directs that this increase in JSF funding be used only for acceleration of alternate engine development.

The Senate Armed Services Committee report (S.Rept. 106-50 of May 17 [legislative day May 14], 1999) on S. 1059 discussed the JSF program on page 204, stating in part:

> The budget request included $476.6 million ($241.2 million in Navy research and development and $235.4 million in Air Force research and development) for continued development of the joint strike fighter (JSF). Within that total, $33.0 million is included for the alternate engine program. The committee remains concerned that development of an alternate engine for the JSF will not proceed to a point where it represents a viable alternative and reduces risk for the vertical and short take off and landing (V/STOL) JSF variant. The committee recommends an additional $15.0 million in PE 63800F to reduce risk and accelerate development of the alternate engine, a total Air Force authorization of $250.4 million.

FY2001

Defense Authorization Act (H.R. 4205/P.L. 106-398 of October 30, 2000) [147]

The conference report (H.Rept. 106-945 of October 6, 2000) on H.R. 4205 discussed the JSF program on pages 677-678, stating in part:

> The conferees are also concerned about the apparent pattern of additional contractor funding required to sustain the current DEMVAL activities of the program. Since the JSF program is potentially one of the largest acquisition programs in the Department of Defense, both competing contractors in this winner-take-all competition realize the significance of winner selection. However, the conferees are opposed to the requirement for industry to make additional, unreimbursed investments in the JSF program beyond existing contractual agreements. The conferees view the additional DEMVAL funding as necessary to provide for the execution of those projects presented in the budget request on the extended schedule. The conferees expect that risk mitigation projects, including the alternate engine, will be funded to the levels presented in the budget request.

The House Armed Services Committee report (H.Rept. 106-616 of May 12, 2000) on H.R. 4205 discussed the JSF program on pages 252-253, stating in part:

> Additionally, while the Department is currently reviewing the planned JSF "winner take all" strategy to ensure that aircraft industrial base concerns are addressed, the committee notes that no specific concern has been stated with respect to the future stability of the fighter aircraft engine industrial base. The committee supports continuation of the JSF alternate engine program (AEP) as directed in section 211 [sic: 213] of the National Defense Authorization Act for Fiscal Year 1998 (P.L. 105–85) and recommends that the Department specifically address measures to ensure the health of the fighter aircraft engine industrial base in any proposed restructure of the acquisition program for JSF.

[147] H.R. 5408, the FY2001 defense authorization act, is incorporated in H.Rept. 106-945, the conference report on H.R. 4205. The text of H.R. 5408 is included in the conference report.

> The committee also notes that the JSF AEP, as currently funded, will not be capable of completing development and flight qualification of the alternate engine until after award of lot five of the JSF production program. In order to reduce risk to JSF production and aircraft fielding, the Committee supports acceleration of AEP development to ensure that the alternative engine completes configuration compatibility for the JSF airframe.
>
> The committee recommends $299.5 million in PE 64800F, $131.6 million in PE 63800N, and $296.0 million in PE 64800N, the requested amounts. The committee also recommends $144.5 million in PE 63800F, an increase of $15.0 million, to accelerate the JSF AEP.

DOD Appropriations Act (H.R. 4576/P.L. 106-259 of August 9, 2000)

The Senate Appropriations Committee report (S.Rept. 106-298 of May 18, 2000) on S. 2593, the companion bill to H.R. 4576, discussed the JSF program on pages 116-177, stating in part:

> The Committee also continues to support the Alternate Engine Program (AEP) for JSF and expects that the recommended changes in overall JSF funding will not impact the current AEP schedule and that no funds will be diverted from the existing AEP plan.

FY2002

Defense Authorization Act (S. 1438/P.L. 107-107 of December 28, 2001)

The conference report (H.Rept. 107-333 of December 12, 2001) on S. 1438 discusses the JSF program on page 574, stating in part:

> The conferees remain concerned about the technical risks associated with the JSF aircraft engine and expect the Department to develop and integrate the JSF alternate engine within the EMD program. The conferees believe that the Department should execute the alternate engine program with a goal of having that engine integrated into the JSF prior to full rate production.

The House Armed Services Committee report (H.Rept. 107-194 of September 4, 2001) on H.R. 2586, the companion bill to S. 1438, discussed the JSF alternate engine program on page 220, stating:

> The budget request contained $769.5 million in PE 64800F to begin the engineering and manufacturing development phase of the JSF program, but included no funds to reduce development schedule risk of the alternate engine common hardware components.
>
> The JSF program will develop and field a family of aircraft that meets the needs of the Navy, Air Force, Marine Corps, and allies with commonality among the variants to minimize life cycle costs. The committee notes that the JSF joint program office (JPO) has encouraged two engine manufacturers to work together on the co-development of propulsion components which are common to both the JSF's current F-119 engine and the F-120 alternate engine[148] and understands that this effort will develop two interchangeable propulsion systems while preserving the proprietary interests of each manufacturer. The committee also understands

[148] These were earlier designations for the F135 and F136 engines, respectively. The F135 engine is a derivative of the F119 engine, which is the engine for the F-22 fighter.

> that the JPO supports production of the F-120 alternate engine as part of the low-rate initial JSF production scheduled for fiscal year 2009 but believes that increased funding in fiscal year 2002 is required to reduce development schedule risk of the common hardware components.
>
> Accordingly, the committee recommends $779.5 million in PE 64800F, an increase of $10.0 million, to reduce development schedule risk of the JSF alternate engine common hardware components.

FY2003

DOD Appropriations Act (H.R. 5010/P.L. 107-248 of October 23, 2002)

The conference report (H.Rept. 107-732 of October 9, 2002) on H.R. 5010 states on page 279:

> The conferees have included an additional $29,750,000 for the Joint Strike Fighter Interchangeable Engine Program only to continue the current effort to develop and maintain two, competing, interchangeable engine programs for the Joint Strike Fighter.

FY2004

Defense Authorization Act (H.R. 1588/P.L. 108-136 of November 24, 2003)

The SENATE ARMED SERVICES COMMITTEE report (S.Rept. 108-46 of May 13, 2003) on S. 1050, the companion bill to H.R. 1588, notes on page 4 the recommendation for $56 million in additional funding for the JSF program. The report discussed the JSF program on page 185, stating in part:

> The committee believes that the interchangeable engine should be made available for competitive procurement as early as possible. The result of a reduction to this program would be to delay the interchangeable engine by at least two years.
>
> Therefore, the committee recommends an increase of $56.0 million in PE 64800N to continue the F136 interchangeable engine development on its original schedule. The committee believes that the Department of Defense should make the financial adjustments to the Future Years Defense Program that are necessary to restore the original interchangeable engine schedule.

DOD Appropriations Act (H.R. 2658/P.L. 108-87 of September 30, 2003)

The Senate Appropriations Committee report (S.Rept. 108-87 of July 10, 2003) on S. 1382, the companion bill to H.R. 2658 discussed the JSF program on page 157, stating:

> The Committee is dismayed that the Joint Strike Fighter program office was permitted to take a reduction for inflation savings disproportionately against the F136 Interchangeable Engine. This cut resulted in a $56,000,000 reduction to this engine's research and development effort in fiscal year 2004.

> The Committee has been supportive of this engine development program for several years and has, in fact, increased funding to accelerate this engine's development. This cut to the program flies in the face of longstanding Committee support.
>
> The Committee, therefore, recommends a total cut of $56,000,000 to the Joint Strike Fighter program which is to be taken equally from the Navy and the Air Force Joint Strike Fighter programs with the exception of the F136 engine program. The Committee also recommends that the fiscal year 2004 cut to the F136 Interchangeable Engine be restored to the original program with an appropriate adjustment for the inflation cut.
>
> Finally, the Committee has added $20,000,000 to this program only for risk reduction to the F136 Interchangeable Engine program.

FY2005

Defense Authorization Act (H.R. 4200/P.L. 108-375 of October 28, 2004)

The House Armed Services Committee report (H.Rept. 108-491 of May 14, 2004) on H.R. 4200 discussed the JSF program on page 183, stating in par:

> In order to maintain competition for the engine for the JSF, Congress has mandated the funding of an alternate engine program and the JSF Joint Program Office (JPO) is working with the contractor propulsion teams to provide for completely interchangeable engines.
>
> The committee believes that the earliest possible engine production lot competition is beneficial to the JSF program. The committee directs the JSF JPO plan to compete, at the earliest possible date, engine common hardware as well as the turbomachinery, while maintaining PW F135 and GE F136 engine interchangeability.

FY2006

Defense Authorization Act (H.R. 1815/P.L. 109-163 of January 6, 2006)

The House Armed Services Committee report (H.Rept. 109-89 of May 20, 2005) on H.R. 1815 discussed the JSF program on pages 92-93, stating in part:

> Additionally, the committee understands that during the preparation of the fiscal year 2006 budget request that there were efforts by some within the military services to eliminate planned budgets for the JSF competitive engine development program. Despite those views, the committee also understands that the Secretary of Defense ensured that the engine program was nominally funded. The committee believes that a two-engine source for the single-engine JSF would be the most cost effective and operationally effective engine solution during the JSF's service life, and therefore expects that the Secretary, along with Department of the Navy and the Department of the Air Force, will remain committed to the development of competitive engines for the JSF.

FY2007

Defense Authorization Act (H.R. 5122/P.L. 109-364 of October 17, 2006)

Section 211 of H.R. 5122/P.L. 109-364 states:

> SEC. 211. ACQUISITION OF, AND INDEPENDENT COST ANALYSES FOR, THE JOINT STRIKE FIGHTER PROPULSION SYSTEM.
>
> (a) ACQUISITION.—
>
> (1) IN GENERAL.—The Secretary of Defense shall provide for the development and procurement of the propulsion system for the Joint Strike Fighter aircraft through the continued development and sustainment of two interchangeable propulsion systems for that aircraft by two separate contractors throughout the life cycle of the aircraft.
>
> (2) MODIFICATIONS PROHIBITED.—Except as provided by paragraph (3), the Secretary may not carry out any modification to the acquisition program for the Joint Strike Fighter aircraft that would result in the development or procurement of the propulsion system for that aircraft in a manner other than that required by paragraph (1).
>
> (3) MODIFICATIONS ALLOWED.—Notwithstanding paragraph (1), a modification described in paragraph (2) may be carried out to the extent that each of the following requirements is met:
>
> (A) The Secretary of Defense has notified the congressional defense committees of the modification.
>
> (B) Each of the reports required by subsection (b) has been submitted.
>
> (C) Funds are appropriated for that purpose pursuant to an authorization of appropriations.
>
> (b) INDEPENDENT COST ANALYSES.—
>
> (1) IN GENERAL.—A comprehensive and detailed cost analysis of the Joint Strike Fighter engine program shall be independently performed by each of the following:
>
> (A) The Comptroller General.
>
> (B) A federally funded research and development center selected by the Secretary of Defense.
>
> (C) The Secretary of Defense, acting through the Cost Analysis Improvement Group of the Office of the Secretary of Defense.
>
> (2) MATTERS COVERED.—Each such cost analysis shall cover—
>
> (A) an alternative under which the Joint Strike Fighter aircraft is capable of using the F135 engine only;
>
> (B) an alternative under which the program executes a one-time firm-fixed price contract for a selected propulsion system for the Joint Strike Fighter aircraft for the life cycle of the aircraft following the Initial Service Release of the propulsion system in fiscal year 2008;

(C) an alternative under which the Joint Strike Fighter aircraft is capable of using either the F135 engine or the F136 engine, and the engine selection is carried out on a competitive basis; and

(D) any other alternative, whether competitive or sole source, that would reduce total life-cycle cost, improve program schedule, or both.

(3) REPORTS.—Not later than March 15, 2007, the Secretary of Defense, the Comptroller General, and the chief executive officer of the federally funded research and development center selected under paragraph (1)(B) shall independently submit to the congressional defense committees a report on the cost analysis carried out under paragraph (1). Each such report shall include each of the following matters:

(A) The key assumptions used in carrying out the cost analysis.

(B) The methodology and techniques used in carrying out the cost analysis.

(C) For each alternative required by paragraph (2)—

(i) a comparison of the life-cycle costs, including costs in current and constant dollars and a net-present-value analysis;

(ii) estimates of—

(I) supply, maintenance, and other operations manpower required to support the alternative;

(II) the number of flight hours required to achieve engine maturity and the year in which that is expected to be achieved; and

(III) the total number of engines expected to be procured over the lifetime of the Joint Strike Fighter program; and

(iii) an evaluation of benefits, other than cost, provided by competition, to include an assessment of improved performance, operational readiness and warfighting capability, risk reduction, technology innovation, and contractor responsiveness.

(D) A description of the acquisition strategies (including development and production) that were used for, and experience with respect to cost, schedule, and performance under, past acquisition programs for engines for tactical fighter aircraft, including the F–15, F–16, F–18, and F–22 aircraft.

(E) A comparison of the experiences under past acquisition programs carried out on a sole-source basis with respect to performance, savings, maintainability, reliability, and technical innovation.

(F) The impact that canceling the F136 competitive engine would have on the high-performance military engine industrial base, and on the Department of Defense's ability to make competitive engine choices for future combat aircraft systems beyond the Joint Strike Fighter.

(G) Conclusions and recommendations.

(4) CERTIFICATIONS.—In submitting the report required by paragraph (3), the Comptroller General and the chief executive officer of the federally funded research and

> development center shall also submit a certification as to whether the Secretary of Defense provided access to sufficient information to enable the Comptroller General or the chief executive officer, as the case may be, to make informed judgments on the matters required to be included in the report.
>
> (c) LIFE-CYCLE COSTS DEFINED.—In this section, the term ''lifecycle costs'' includes—
>
> (1) those elements of cost that would be considered for a life-cycle cost analysis for a major defense acquisition program, including procurement of engines, procurement of spare engines, and procurement of engine components and parts; and (2) good-faith estimates of routine engine costs (such as performance upgrades and component improvement) that historically have occurred in tactical fighter engine programs.

The House Armed Services Committee report (H.Rept. 109-452 of May 5, 2006) on H.R. 5122 discussed the JSF program on pages 105-106 and 220-221. The discussion on pages 220-221 states in part:

> The budget request contained $2.0 billion in PE 64800F for the Department of the Air Force's development of the joint strike fighter (JSF), also known as the F–35, but included no funds for research and development of a second aircraft tire source for the JSF and other existing combat aircraft, or for development of an alternate JSF engine. The committee notes that the budget request also includes $2.0 billion in PE 64800N for the Department of the Navy's development of JSF....
>
> The JSF alternate engine program is developing the F136 engine which would provide an alternative to the currently-planned F135 engine. In the committee report (H. Rept. 109–89) accompanying the National Defense Authorization Report for Fiscal Year 2006, the committee expressed its belief that a two-engine source for the single-engine JSF would be the most cost effective and operationally effective engine solution during the JSF's service life, and is disappointed that the budget request did not include funds for development of an alternate JSF engine beyond fiscal year 2006. During a hearing held by the Subcommittee on Tactical Air and Land Forces on March 16, 2006, the Under Secretary of Defense for Acquisition, Technology, and Logistics testified, ''While the benefits of a second supplier are undeniable, our judgment is that those benefits are not worth the substantial financial cost of a second supplier.'' To confirm those judgments, the committee requested that the Government Accountability Office (GAO) witness at the hearing review and report on the Department of Defense's analysis that resulted in the judgment to terminate the JSF alternate engine program. On April 12, 2006, the GAO witness reported to the committee that the ''Department of Defense's quantitative analysis focuses only on potential savings for engine acquisition and does not appear to fully examine potential savings that may be possible when competition exists for providing support for maintenance and operations over the lifecycle of the engine.'' The committee concurs with GAO's observation, and believes that the JSF alternate engine program should continue until the Department of Defense fully analyzes potential costs and savings resulting from competition over the JSF engine's lifecycle.
>
> Accordingly, the committee recommends an increase of $408.0 million to continue the JSF alternate engine program for fiscal year 2007. Additionally, the committee recommends a provision (section 211) that would require that the Department of the Navy and the Department of the Air Force obligate not less than $408.0 million, of the funds authorized to be appropriated for the system development and demonstration program for the Joint Strike Fighter, for continued development of an alternate engine for the Joint Strike Fighter. The committee also recommends a provision (section 215) that would require both the Secretary of Defense, acting through the Department of Defense Cost Analysis Improvement Group,

> and the Comptroller General to conduct independent analyses of the JSF alternate engine program and provide a report to the congressional defense committees by March 15, 2007.

The Senate Armed Services Committee report (S.Rept. 109-254 of May 9, 2006) on S. 2766, the companion bill to 5122, states on page 6:

> In order to confront irregular warfare threats, the Department must modernize and transform the armed forces. Since 2001, the Department has undergone significant modernization and transformation even during a time of war. The committee supported the Department's transformational activities, including authorizing funds for the construction of eight ships, for a total of $12.1 billion; including a provision to promote coordinated joint development, procurement, and operation of unmanned systems; adding funds for the continued development of the Joint Strike Fighter interchangeable engine during fiscal year 2007; authorizing the budget request of $3.7 billion for the Army's Future Combat Systems program; and authorizing an increase of nearly $365.0 million over the President's budget request of $11.1 billion for science and technology programs.

The report states on page 7:

> Increasingly, the committee has emphasized the importance of developing capabilities to plan and conduct coalition operations. Ten years ago, the committee expressed concerns regarding the lack of engine competition in the Joint Strike Fighter program. As a result, the committee included a provision in the National Defense Authorization Act for Fiscal Year 1996 (Public Law 104–106) that directed the Secretary of Defense to evaluate at least two propulsion concepts from competing engine companies. Recently, the committee held hearings to review the Department's unilateral proposal, despite legislative direction to maintain a two-engine program, to eliminate the development of the F136 alternate interchangeable engine from the Joint Strike Fighter program. The committee remains concerned that relying on one engine provider to perform multiple missions, for multiple services and multiple nations presents an unnecessary operational and financial risk to the United States. Accordingly, the committee authorized provisions adding $400.8 million for the continued development of the interchangeable engine during fiscal year 2007; and directing the Secretary of Defense to continue the development and sustainment of the Joint Strike Fighter program with two competitive propulsion systems throughout the life of the aircraft or enter into a one-time, firm-fixed-price contract for a single propulsion system throughout the life of the aircraft.

The report discussed two proposed legislative provisions on pages 129-131, stating:

> **Development of the propulsion system for the Joint Strike Fighter (sec. 254)**
>
> The committee recommends a provision that would direct the Secretary of Defense to continue the development and sustainment of the Joint Strike Fighter (JSF) program with two competitive propulsion systems throughout the life cycle of the aircraft, or enter into a one-time firm-fixed-price contract for a selected propulsion system for the life cycle of the aircraft following the initial service release of the JSF F135 propulsion system in fiscal year 2008.
>
> During the 1970's and early 1980's, Pratt & Whitney was the sole source provider of engines for the F–14, F–15, and F–16 aircraft. Because of persistent engine problems that resulted in the loss of aircraft and degraded readiness, Congress directed the Department of Defense to develop and produce an engine to compete with Pratt & Whitney engines on these aircraft. The benefits that resulted from this competition included improved performance, reduced risk, increased readiness, lower cost of ownership, improved contractor responsiveness to

customer needs, and over $4.0 billion of cost savings. Congress once again directed the Department to provide for an engine competition for the JSF in 1996 out of concerns for a lack of competition expressed in the National Defense Authorization Act for Fiscal Year 1996 (P.L. 104–106). Congress has consistently supported a competitive engine program for the Joint Strike Fighter for the past 10 years.

The JSF program is the largest acquisition program, in terms of funding, in Department of Defense history. Total JSF deliveries may well exceed 4,000 aircraft worldwide, with a resultant level of propulsion business in the tens of billions of dollars. The committee is concerned that relying on a sole engine supplier for a single-engine aircraft to do multiple missions for multiple services and multiple nations presents an unnecessary operational and financial risk to our nation.

The committee is also concerned that the Department's analysis provided to the committee, as justification for the termination of the F136 interchangeable engine, accounted for only 30 percent of the engine costs over the life cycle of the aircraft and failed to comply with the Department's policy on economic analysis that would have required the inclusion of the total life cycle cost. If the Department had conducted a full life cycle analysis, the committee believes that the results of the analysis would show significant cost savings that could be achieved through a competitive engine strategy. The committee believes that through the enduring value of competition, sufficient savings will be generated from a series of competitive engine procurements over the life cycle of the aircraft that will more than offset the cost of completing the F136 engine development. In order to ensure that the Congress has the complete picture of the full life cycle costs, the committee has recommended another provision described elsewhere in this report that would require the Secretary of Defense and the Comptroller General to conduct independent life cycle cost analyses addressing this issue.

Independent cost analyses for Joint Strike Fighter engine program (sec. 255)

The committee recommends a provision that would direct the Secretary of Defense, a federally-funded research and development center (FFRDC) chosen by the Secretary, and the Comptroller General to conduct independent life cycle cost analyses of the development and sustainment of the Joint Strike Fighter (JSF) program with two competitive propulsion systems throughout the life cycle of the aircraft, versus terminating the alternate engine development and proceeding with only one engine.

The provision would also require that the Comptroller and the FFRDC certify that they had access to sufficient information upon which to make informed judgments on the life cycle costs of the two alternatives.

As noted elsewhere in this report, the committee is concerned that the Department of Defense analysis provided as justification for the termination of the F136 interchangeable engine did not account for all of the costs over the life cycle of the aircraft.

The report discussed the JSF program on pages 95-96 and 179. The discussion on page 179 states:

F136 Interchangeable Engine

The budget request included $1,999.0 million in PE 64800F and $2,031.0 million in PE 64800N for the continued development of the Joint Strike Fighter, but included no funding for the development of the F136 interchangeable engine. The committee believes supporting competitive propulsion systems would help reduce operational risk and lead to higher

> confidence of achieving more affordable life cycle costs. The committee expects that the Secretary of Defense, along with the Department of the Navy and the Department of the Air Force, will remain committed to the development and sustainment of competitive propulsion systems for the Joint Strike Fighter.
>
> The committee recommends an increase of $200.4 million in PE 64800F and an increase of $200.4 million in PE 64800N for the continued development of the F136 interchangeable engine.

DOD Appropriations Act (H.R. 5631/P.L. 109-289 of September 29, 2006)

The conference report (H.Rept. 109-676 of September 25, 2006) on H.R. 5631 discussed the JSF program on pages 205 and 228. The discussion on pages 228 states:

> The conferees recommend an additional $170,000,000 in Research, Development, Test and Evaluation, Air Force and $170,000,000 in Research, Development, Test and Evaluation, Navy for continuing development of the F–136 engine for the Joint Strike Fighter program. The conferees direct the Under Secretary of Defense for Acquisition, Technology and Logistics to sponsor a comprehensive independent cost analysis of the Joint Strike Fighter engine program. The conferees strongly encourage the analysis be conducted by the Institute for Defense Analyses (IDA). This analysis shall include but not be limited to: (1) a comparison of costs associated with the development of the F–135 and F–136 engines; (2) an evaluation of potential savings achieved by eliminating or continuing the development and production of an alternate engine over the program's life cycle; and (3) the potential effects on the industrial base of eliminating or continuing the development and production of an alternate engine over the program's life cycle. This analysis shall be transmitted to the congressional defense committees not later than March 15, 2007.
>
> The conferees in no way intend for this analysis to be an excuse for the Department of Defense not to fully fund the development of both the F–135 and the F–136 engines in fiscal year 2008. All evidence suggests that the development of two alternate engines will lead to cost savings through competition, increased capabilities for the warfighter, and a strengthened industrial base. Accordingly, the conferees direct the Department of Defense to fund the continued development of both the engines in the fiscal year 2008 budget submission while this cost analysis is ongoing.

The House Appropriations Committee report (H.Rept. 109-504 of June 16, 2006) on H.R. 5631 discusses the JSF program on page 163 and 266. The discussion on page 266 states:

> The budget request provided no funding for development of the F–136 engine for the Joint Strike Fighter program. The Committee recommends an additional $200,000,000 for continued development of this alternate engine source. The Committee directs the Under Secretary of Defense for Acquisition, Technology and Logistics to sponsor a comprehensive independent cost analysis of the Joint Strike Fighter engine program to be conducted by a federally funded research and development center (FFRDC) with demonstrated competence in this area. This analysis shall include but not be limited to: (1) a comparison of costs associated with the development of the F–135 and F–136 engines; (2) an evaluation of potential savings achieved by eliminating or continuing the development and production of an alternate engine over the program's life cycle; and (3) the potential effects on the industrial base of eliminating or continuing the development and production of an alternate engine over the program's life cycle. This analysis shall be transmitted to the congressional defense committees not later than March 15, 2007.

> The Committee is supportive of required studies included in the House-passed version of the National Defense Authorization Act, 2007, and intends that this cost analysis be complementary to those studies.

The Senate Appropriations Committee report (S.Rept. 109-292 of July 25, 2006) on H.R. 5631 discusses the JSF program on pages 76-77 and 157. The discussion on page 157 states:

> The Committee is disappointed that the Department of Defense did not include funding for the F–35 Joint Strike Fighter 2nd Engine Source in the fiscal year 2007 budget request. Although the Committee recognizes that the Department of Defense faces difficult budget challenges, the Committee also believes it is premature to cancel the second engine source. Experience with the F–16 Fighter program engine competition led to a more reliable, better performing and lower cost engine. The Committee believes that competition for the F–35 engine is critical to procuring the best value engine at the lowest price and that competition will likely lead to an overall savings across the life cycle of the fighter program. Therefore, the Committee recommends an additional $170,000,000 to each of the Navy and Air Force Research, Development, Test and Evaluation accounts. The Committee also directs the Department of Defense to fund the continued development of both engines in future budget submissions.

FY2008

Section 213 of H.R. 4986/P.L. 110-181 states:

> SEC. 213. REQUIREMENT TO OBLIGATE AND EXPEND FUNDS FOR DEVELOPMENT AND PROCUREMENT OF A COMPETITIVE PROPULSION SYSTEM FOR THE JOINT STRIKE FIGHTER.
>
> Of the funds appropriated pursuant to an authorization of appropriations or otherwise made available for fiscal year 2008 or any year thereafter, for research, development, test, and evaluation and procurement for the Joint Strike Fighter Program, the Secretary of Defense shall ensure the obligation and expenditure in each such fiscal year of sufficient annual amounts for the continued development and procurement of 2 options for the propulsion system for the Joint Strike Fighter in order to ensure the development and competitive production for the propulsion system for the Joint Strike Fighter.[149]

H.R. 4986 is a revised version of H.R. 1585, which was vetoed on December 12, 2007. The House Armed Services Committee report (H.Rept. 110-146 of May 11, 2007) on H.R. 1585 discussed the JSF program on pages 213-214, stating:

> The budget request contained $1.8 billion in PE 64800F, and $1.7 billion in PE 64800N, for development of the Joint Strike Fighter (JSF), but contained no funds for development of a competitive JSF propulsion system.
>
> The competitive JSF propulsion system program is developing the F136 engine, which would provide a competitive alternative to the currently-planned F135 engine. In the committee report (H. Rept. 109–452) accompanying the National Defense Authorization Act for Fiscal Year 2007, the committee recommended an increase for the JSF competitive propulsion system, and notes that the other three congressional defense committees also

[149] In the conference report (H.Rept. 110-477 of December 6, 2007) on H.R. 1585, the text of section 213 reads "two options" rather than "2 options."

> recommended increases for this purpose. Section 211 of the John Warner National Defense Authorization Act for Fiscal Year 2007 (Public Law 109–364) required that the Secretary of Defense, acting through the Department of Defense Cost Analysis Improvement Group, the Comptroller General, and a federally funded research and development center each provide an independent lifecycle cost analysis of the JSF propulsion system, which would include a competitive engine program by March 15, 2007. On March 22, 2007, the Subcommittees on Air and Land Forces and Seapower and Expeditionary Forces held a hearing, which included witnesses from the Department of Defense, the Institute for Defense Analyses, and the Government Accountability Office (GAO), to receive testimony regarding their findings on the JSF propulsion system. The committee believes the results of these studies were, in the aggregate, inconclusive on whether there would be a financial benefit to the Department in continuing to develop a competitive propulsion system for the JSF program. However, the committee notes that all studies identified significant non-financial factors of a two-engine competitive program, which include: better engine performance; improved contractor responsiveness; a more robust industrial base; increased engine reliability; and improved operational readiness. The committee believes that the benefits, which could be derived from the non-financial factors, favor continuing the JSF competitive propulsion system program, and recommends an increase of $480.0 million for this purpose.
>
> The committee recommends $1.8 billion in PE 64800N, an increase of $115.0 million, and directs that $240.0 million of the recommended funds be used for the competitive JSF propulsion system program; and $1.9 billion in PE 64800F, an increase of $115.0 million, and directs that $240.0 of the recommended funds be used for the competitive JSF propulsion system program.
>
> Additionally, the committee recommends a provision (section 213) that would require the Secretary of Defense to obligate sufficient annual amounts to develop and procure a competitive propulsion system for the JSF program, in order to conduct a competitive propulsion source selection, from funds appropriated pursuant to an authorization of appropriations or otherwise made available for research, development, test, and evaluation, and procurement for the JSF program. The committee notes that current plans for the competitive JSF propulsion system would complete the development of the competitive propulsion system so that a competition for the JSF propulsion would occur in fiscal year 2012 with the sixth lot of low-rate initial production aircraft.

The Senate Armed Services Committee report (S.Rept. 110-77 of June 5, 2007) on S. 1547, the companion bill to H.R. 1585, discussed a proposed legislative provision on pages 139-140, stating:

> The committee recommends a provision that would require the Secretary of Defense to obligate sufficient annual amounts to develop and procure a competitive propulsion system for the Joint Strike Fighter (JSF) program, in order to conduct a competitive propulsion source selection, from funds appropriated pursuant to an authorization of appropriations or otherwise made available for research, development, test, and evaluation, and procurement for the JSF program. The committee notes that current plans for the competitive JSF propulsion system would complete the development of the competitive propulsion system so that a competition for the JSF propulsion system would occur in fiscal year 2012 with the sixth lot of low-rate initial production.
>
> The budget request contained $1.7 billion in PE 64800N, and $1.8 billion in PE 64800F for development of the JSF, but contained no funds for development of a competitive JSF propulsion system.
>
> The competitive JSF propulsion system program is developing the F136 engine, which would provide a competitive alternative to the current baseline F135 engine. Section 211 of

> the John Warner National Defense Authorization Act for Fiscal Year 2007 (Public Law 109–364) required that, by March 15, 2007, the Secretary of Defense, acting through the Department of Defense Cost Analysis Improvement Group, the Comptroller General, and a federally funded research and development center, each provide an independent life cycle cost analysis of the JSF propulsion system, which would include a competitive engine program. The committee has been briefed on the results of these reviews and believes those results were, in the aggregate, inconclusive on whether there would be a financial benefit to the Department of Defense in continuing to develop a competitive propulsion system for the JSF program.
>
> However, the committee notes that all studies identified significant non-financial factors of a two-engine competitive program that should be considered in deciding between the alternatives. These factors include: better engine performance; improved contractor responsiveness; a more robust industrial base; increased engine reliability; and improved operational readiness. The committee believes that the potential benefits from the non-financial factors favor continuing the JSF competitive propulsion system program. Therefore, the committee recommends an increase of $480.0 million for this purpose, including $240.0 million in PE 64800N, and $240.0 million in PE 64800F.

DOD Appropriations Act (H.R. 3222/P.L. 110-116 of November 13, 2007)

The House Appropriations Committee report (H.Rept. 110-279 of July 30, 2007) on H.R. 3222 discussed the JSF program on page 6, stating:

> The success of the Department's Joint Strike Fighter (F–35) program is critical to our Nation's ability to field a modern, capable fighter aircraft fleet for decades to come. To maintain stability in this program—and limit the potential for cost increases over time—the Committee recommends an increase of $200,000,000 for F–35 production enhancements. These funds are to be used to outfit facilities with the latest in production line equipment and work-flow technology. In addition, the Committee recommends including $480,000,000 to continue development of an alternative engine for this aircraft, thereby ensuring a competitive base for engine production.

The report discussed JSF the program again on pages 161-162, 211, and 360. The discussion on page 360 states in part:

> The fiscal year 2008 budget request includes no funding for development of the F–136 as an alternate engine within the Joint Strike Fighter program. The Committee recommends $480,000,000 for this effort. These funds have been added to the Air Force and Navy's respective Joint Strike Fighter development lines.
>
> The statement of the managers accompanying the conference report on the Defense Appropriations Act for fiscal year 2007 directed the Department of Defense to fund the continued development of both the F–135 and F–136 engines in the fiscal year 2008 budget request. The Committee notes that this direction was disregarded by the Office of the Secretary of Defense. In exercising its power of the purse, the Committee made the necessary program adjustments to the fiscal year 2008 budget request to fully fund the requirement for this engine development program. The fiscal year 2009 requirement for the F–136 is estimated to be $350,000,000. The Committee again directs the Department of Defense to fully fund this development program in the fiscal year 2009 budget submission.

The Senate Appropriations Committee report (S.Rept. 110-155 of September 14, 2007) on H.R. 3222 discusses the JSF program on page 191, stating:

> The Committee is disappointed that the Department of Defense did not continue funding to support the development of an alternative engine for the F–35 Joint Strike Fighter in the fiscal year 2008 budget request. Although the Committee recognizes that the Department of Defense faces difficult budget challenges, the Committee also believes it is premature to cancel the second engine source. Experience with the F–16 Fighter program demonstrated that engine competition led to a more reliable, better performing and lower cost engine. The Committee believes that competition for the F–35 engine is critical to procuring the best value engine at the lowest price and that competition will likely lead to an overall savings across the life cycle of the fighter program. Therefore, the Committee recommends an additional $240,000,000 in both the Navy and Air Force Research, Development, Test and Evaluation accounts. The Committee also directs the Department of Defense to fund the continued development of both engines in future budget submissions.

FY2009

Defense Authorization Act (S. 3001/P.L. 110-417 of October 14, 2008)

The House Armed Services report (H.Rept. 110-652 of May 16, 2008) on H.R. 5658, the companion bill to S. 3001, discussed the JSF program on pages 227-228, stating:

> The budget request contained $1.5 billion in PE 64800F, and $1.5 billion in PE 64800N, for development of the Joint Strike Fighter (JSF), but contained no funds for development of a competitive JSF propulsion system. The budget request also contained $136.9 million for F–35 advance procurement in Aircraft Procurement, Air Force for the long-lead components necessary to procure 12 F–35A aircraft in fiscal year 2010, but contained no funds for advance procurement of competitive JSF propulsion system long-lead components.
>
> The competitive JSF propulsion system program is developing the F136 engine, which would provide a competitive alternative to the currently-planned F135 engine. In the committee report (H.Rept. 109–452) accompanying the John Warner National Defense Authorization Act for Fiscal Year 2007, and once again in the committee report (H. Rept. 110–146) accompanying the National Defense Authorization Act for Fiscal Year 2008, the committee recommended increases for the JSF competitive propulsion system, and notes that in both cases, the other three congressional defense committees concurred. Despite section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181), which requires the Secretary of Defense to obligate and expend sufficient annual amounts for the continued development and procurement of a competitive propulsion system for the JSF, the committee is disappointed that the Department of Defense (DOD) chose not to comply with both the spirit and intent of this provision by opting not to include funds for this purpose in the budget request.
>
> On March 11, 2008, the Subcommittees on Air and Land Forces and Seapower and Expeditionary Forces held a hearing at which the Undersecretary of Defense for Acquisition, Technology and Logistics (USD (AT&L)) and the Government Accountability Office's (GAO) Director of Acquisition Sourcing and Management testified. Witnesses were asked to provide an update to the independent lifecycle cost analysis of the JSF propulsion system required by section 211 of the John Warner National Defense Authorization Act for Fiscal Year 2007 (Public Law 109–364) based on the obligation of an additional $480.0 million authorized and appropriated for fiscal year 2008, performance of the competitive engine program to date, and the additional year of development. The GAO Director of Acquisition and Sourcing Management complied with the subcommittees' request and testified that the Department of Defense would recoup its initial investment costs with program savings of between 9 and 11 percent, or about 1.3 percent less than the GAO reported in 2007. He also

> testified that at least that amount of savings could be achieved in the long run based on analysis of actual data from the F–16 engine competition. Opting not to comply with the committee request, the USD (AT&L) testified that the Department did not direct the Office of the Secretary of Defense's Cost Analysis and Improvement Group to update its analysis from the previous year, and that there had been no significant changes to the program that would have resulted in any changes to their findings. Based on this testimony, the committee believes that a competitive propulsion system for the JSF offers the promise of long-term savings.
>
> The committee also notes that in August 2007, the currently planned F135 engine experienced a hardware failure during test stand operations with the short take-off and vertical land (STOVL) lift fan engaged, and that a similar failure occurred again in February 2008, and that these engine failure will result in a currently projected delay to the first flight of the F–35 STOVL variant by 30 to 60 days. While the committee understands that the F135 engine is still in development and test failures may occur, the committee believes that, over the long-term, a competitive JSF propulsion program will result in improved engine performance for all JSF variants. These test failure events and the subcommittees' hearing testimony cause the committee to remain steadfast in its belief that the non-financial factors of a two-engine competitive program such as better engine performance, improved contractor responsiveness, a more robust industrial base, increased engine reliability and improved operational readiness strongly favor continuing the competitive propulsion system program.
>
> For continued development of the competitive JSF propulsion system program, the committee recommends $1.8 billion, an increase of $247.5 million in PE 64800F, and $1.8 billion, an increase of $247.5 million in PE 64800N. The committee also recommends $167.9 million, an increase of $31.0 million for advance procurement of competitive JSF propulsion system long-lead components, for F–35 advance procurement in Aircraft Procurement, Air Force. Additionally, the committee strongly urges the Department of Defense to comply with the spirit and intent of section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181) by including the funds necessary for continued development and procurement of a competitive JSF propulsion system in its fiscal year 2010 budget request.

The Senate Armed Services Committee report (S.Rept. 110-335 of May 12, 2008) on S. 3001 discussed the JSF program on pages 99-100, stating:

> The budget request included $136.9 million in Aircraft Procurement, Air Force (APAF) for advanced procurement for the F–35 Joint Strike Fighter (JSF) program. In section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181), Congress explicitly directed the Department of Defense to (1) develop a competitive propulsion system for the JSF aircraft; and (2) continue competition for the propulsion system throughout the production phase of the JSF program.
>
> In order to follow through on that direction and begin competition with the F–135 engine in 2012, the Department of Defense must begin funding for long lead items for the F–136 production line in 2009.
>
> Therefore, the committee recommends in increase of $35.0 million in APAF for long lead items for the F–136 engine.

The report further discussed the JSF program on pages 123-124 and 197. The discussion on page 197 states:

> The budget request included $1,532.7 million in PE 64800N and $1,524.0 million in PE 64800F for the F–35 Joint Strike Fighter (JSF) program. In section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181), Congress explicitly directed the Department of Defense to (1) develop a competitive propulsion system for the JSF aircraft; and (2) continue competition for the propulsion system throughout the production phase of the JSF program.
>
> The committee is disappointed that the administration chose to ignore the law by failing to fund the competitive propulsion system. Accordingly, the committee recommends an increase of $215.0 million in PE 64800N and $215.0 million in PE 64800F for development of the F–35 JSF competitive propulsion system.

The report further discusses the JSF program on page 222, stating:

> The budget request included $1,524.0 million in PE 64800F for the F–35 Joint Strike Fighter (JSF) program. Over the past 2 years, Congress has added $820.0 million to continue funding of the F136 engine, a competitive propulsion source, to ensure there is fair and full competition for the propulsion system of the JSF.
>
> The Department of Defense froze the technology baseline of the F135 engine several years ago when the JSF and the engine began system development and demonstration (SDD). To ensure that both engines incorporate the best configuration and most recent technology available, the Department should invest in and direct a program for the F135 and F136 engine programs that would drive technology insertion and provide potential customers with the best performing, most efficient engines possible. For example, the committee believes that the potential application of new composite materials in the F135 engine program could result in life cycle cost savings. Because no funds were set aside for the F136 engine in the administration's budget request, elsewhere in this report the committee has recommended an increase of $430.0 million for the development of the F–136 engine.
>
> In order to maintain a level playing field, the committee recommends an increase of $35.0 million in PE 64800F for F135 engine technology development.

Consolidated Appropriations Act (H.R. 2638/P.L. 110-329 of September 30, 2008)

The FY2009 DOD Appropriations Act is Division C of H.R. 2638/P.L. 110-329. In lieu of a conference report for H.R. 2638, there was an explanatory statement that was printed as a House Appropriations Committee print dated October 2008 (print 44-807). The committee print discussed the JSF program on page 215, stating:

> The fiscal year 2009 budget request included no funding for the continued development of the F–136 engine as an alternate engine within the Joint Strike Fighter program. The bill includes $430,000,000 for the continued development of this engine within the Navy and Air Force's Joint Strike Fighter development programs and $35,000,000 for advance procurement items within the Aircraft Procurement, Air Force appropriation. The Secretary of Defense is once again directed to fully fund the F–136 engine development and procurement efforts in the fiscal year 2010 budget submission.

Appendix B. F-35 Key Performance Parameters

Table B-1 summarizes key performance parameters for the three versions of the F-35.

Table B-1. F-35 Key Performance Parameters (KPPs)

Source of KPP	KPP	F-35A Air Force CTOL version	F-35B Marine Corps STOVL version	F-35C Navy carrier-suitable version
Joint	Radio frequency signature	Very low observable	Very low observable	Very low observable
	Combat radius	590 nm Air Force mission profile	450 nm Marine Corps mission profile	600 nm Navy mission profile
	Sortie generation	3 surge / 2 sustained	4 surge / 3 sustained	3 surge / 2 sustained
	Logistics footprint	< 8 C-17 equivalent loads (24 PAA)	< 8 C-17 equivalent loads (20 PAA)	< 46,000 cubic feet, 243 short tons
	Mission reliability	93%	95%	95%
	Interoperability	Meet 100% of critical, top-level information exchange requirements; secure voice and data		
Marine Corps	STOVL mission performance – short-takeoff distance	n/a	550 feet	n/a
	STOVL mission performance – vertical lift bring-back	n/a	2 x 1K JDAM, 2 x AIM-120, with reserve fuel	n/a
Navy	Maximum approach speed	n/a	n/a	145 knots

Source: F-35 program office, October 11, 2007.

Notes: PAA is primary authorized aircraft (per squadron); vertical lift bring back is the amount of weapons with which plane can safely land.

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